Z^{+}400 H.V Series

EVALUATION

DATA

DWG No.: IA779-53-01		
APPD	CHK	DWG
17/12/13	for B. 15/12/13	yaniv 24/11/13

TDK-Lambda

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TERMINOLOGY USED

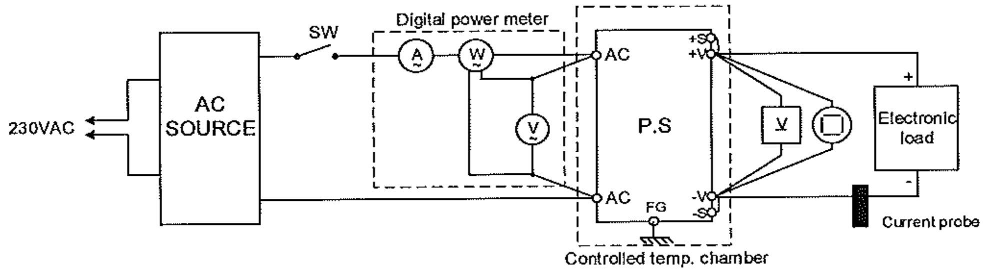
Definition

Vin	Input voltage
Vout	Output voltage
Iin	Input current
Iout	Output current
Ta	Ambient temperature
f	Frequency
C.V	Constant voltage mode
C.C	Constant current mode

1. EVALUATION METHOD

1.1 Circuit used for determination

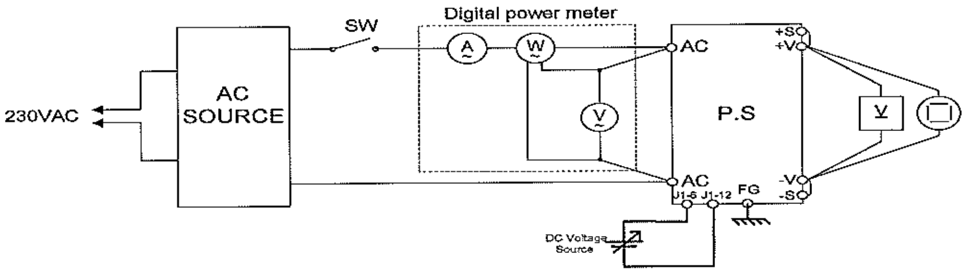
(1) Steady state data



(2) Warm up voltage drift characteristics same as Steady state data

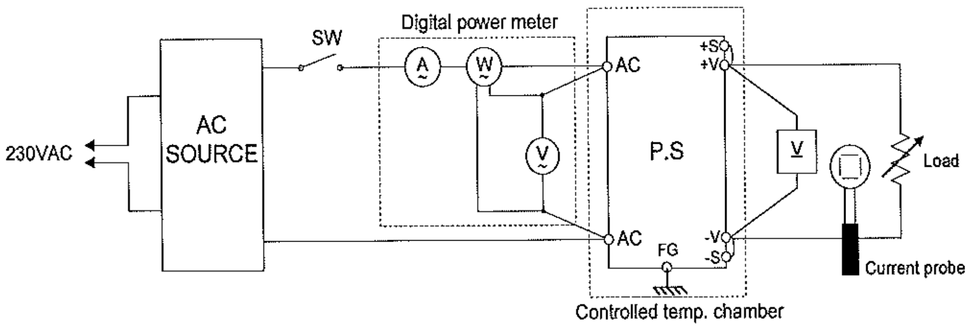
(3) Warm up current drift characteristics same as Steady state data

(4) Over voltage protection (OVP) characteristics



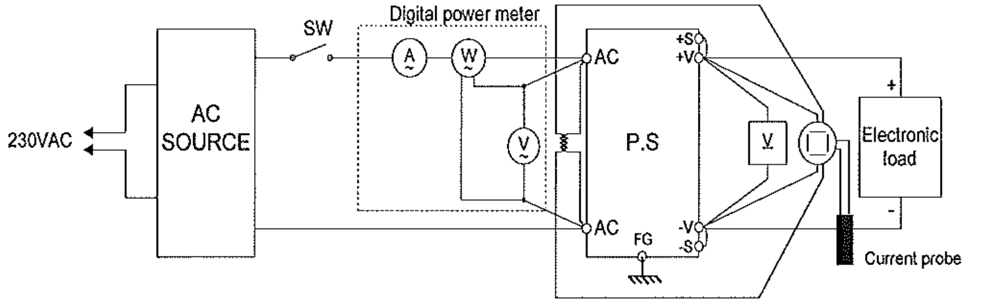
(5) Output voltage rise/fall characteristics same as Steady state data

(6) Output current rise/fall characteristics

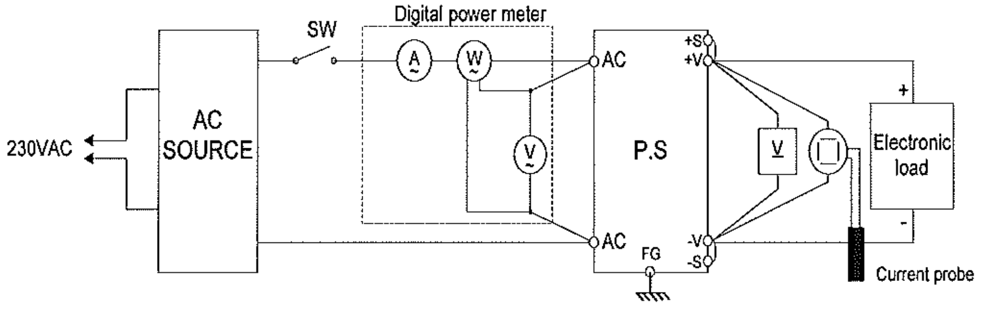


1.1 Circuit used for determination

(7) Dynamic line voltage and current response characteristics

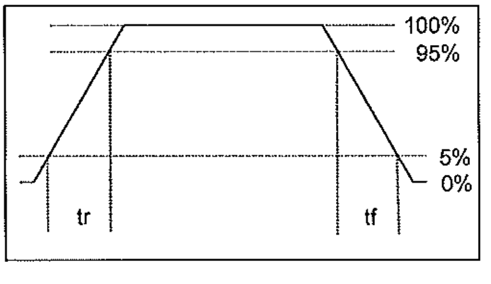


(8) Dynamic load voltage and current response characteristics

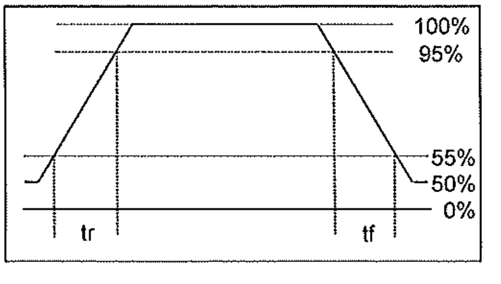


Constant Voltage mode

Output current waveform
Iout 0% <---> 100%

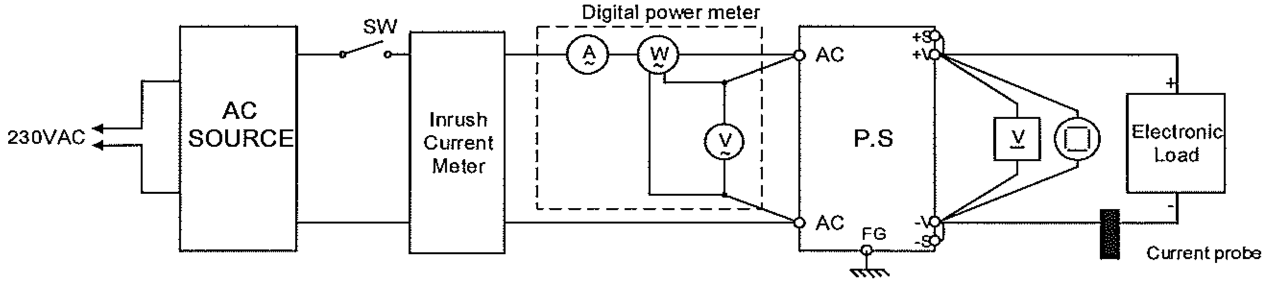


Output current waveform
Iout 50% <---> 100%



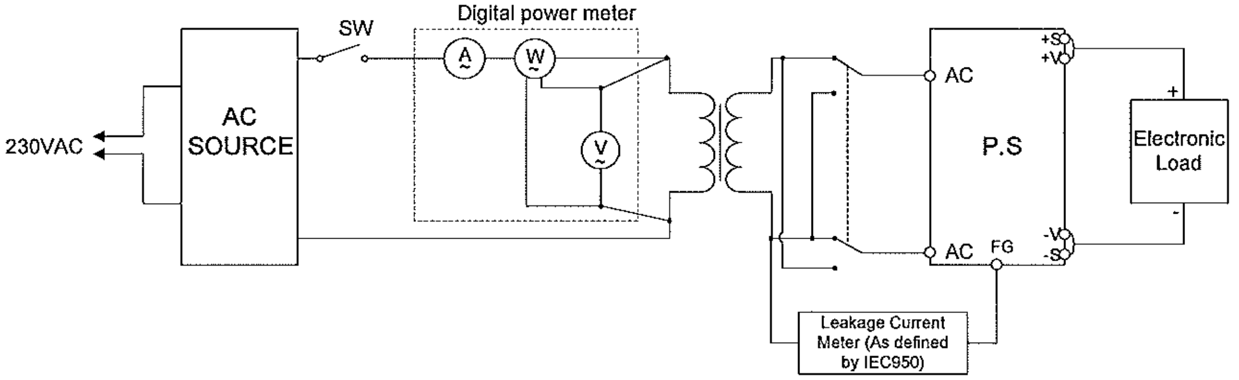
1.1 Circuit used for determination

(9) Response to brown-out characteristics



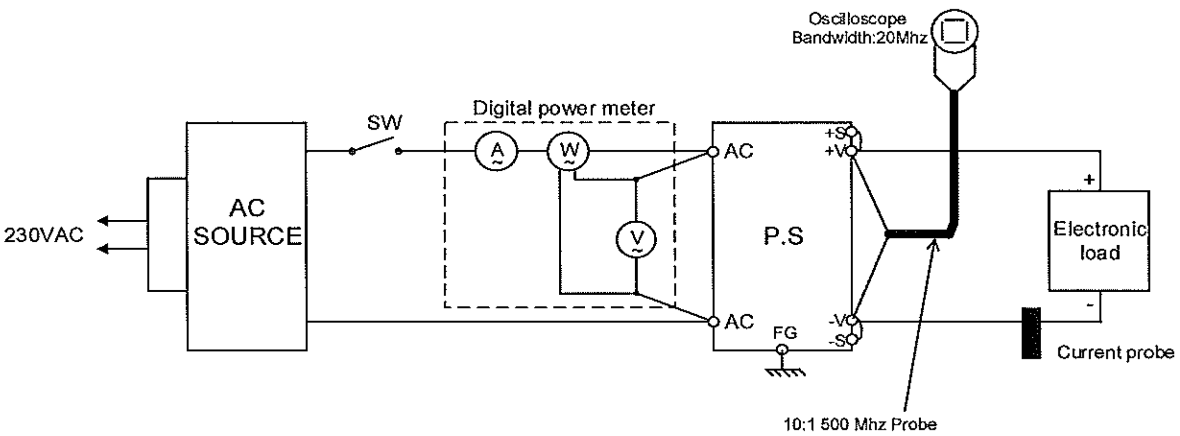
(10) Inrush current characteristics same as Response to brown-out

(11) Leakage current characteristics



(12) Output Voltage ripple & noise waveform 160V up to 650V models

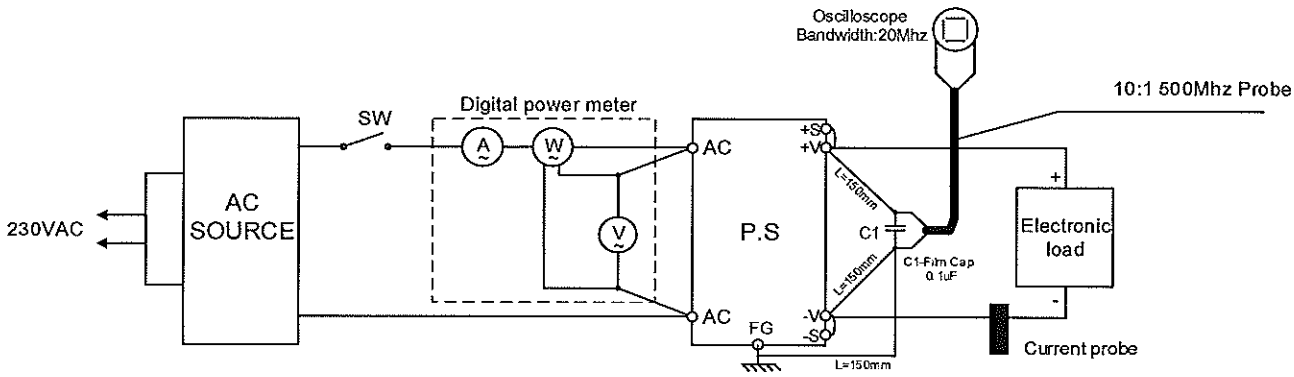
(a) Normal mode (JEITA Standard RC-9131A)



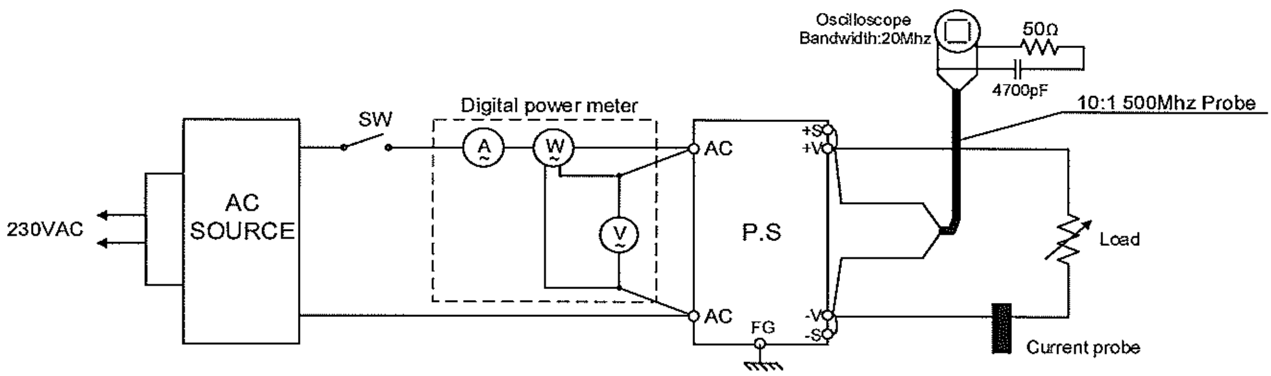
1.1 Circuit used for determination

(12) Output Voltage ripple & noise waveform 160V up to 650V models

(b) Normal + Common mode



(13) Output Current rms ripple 160V to 650V models



Notes:
(*) Ouput Current rms ripple = Output Voltage rms ripple divided by the Load resistance.

1.2 List of equipment used

	EQUIPMENT USED	MANUFACTURER	MODEL No.
1	Digital oscilloscope	YOKOGAWA	DL1740 E/EL
2	Digital multimeter	AGILENT	34401A
3	Digital power meter	YOKOGAWA	WT230 / WT110
4	AC source	CHROMA	6590/6463/6520/6530
5	Electronic load	H&H	ZS1880/ZS7060/ZS4260
6	Electronic load	CHROMA	63202 / 63204
7	Leakage current tester	KIKUSUI	TOS3200
8	Voltage probe	YOKOGAWA	701939/701944
9	Current probe	YOKOGAWA	701933
10	Inrush Current Meter	TAKAMISAWA	PSA-210
11	Data acquisition / switch unit	AGILENT	34970A
12	Controlled temp. chamber	THERMOTRON	SM-16-3800
13	Controlled temp. chamber	THERMOTRON	SM-16-8200
14	Controlled temp. chamber	THERMOTRON	SE-600-5-5
15	Controlled temp. chamber	THERMOTRON	SE-600-6-6

2.1 Steady state data

(1) Regulation - Line & Load, Temperature drift

Z160-2.6

Conditions: Ta = 25°C

1. Regulation - Line & Load, C.V mode (Readings in [V])

	Vin (AC)					
Io	**85**	**100**	**200**	**265**	**Line Regulation**	
0%	159.9690	159.9690	159.9689	159.9689	0.1	0.000
25%	159.9681	159.9679	159.9681	159.9680	0.2	0.000
50%	159.9677	159.9673	159.9678	159.9674	0.5	0.000
75%	159.9668	159.9665	159.9672	159.9671	0.7	0.000
100%	159.9659	159.9662	159.9664	159.9663	0.5	0.000
Load Regulation	3.1	2.8	2.5	2.6	**ΔV(mV)**	**(%)**
	0.002	0.002	0.002	0.002	**(%)**	

2. Temperature drift, C.V mode

Conditions: Vin:100Vac
Iout:100%

Ta	**0°C**	**25°C**	**50°C**	**Temp. Coefficient (0°C~50°C)**	
Vout	159.981	159.948	159.922	59 mV	7 ppm/°C

2.1 Steady state data

(1) Regulation - Line & Load, Temperature drift

Z650-0.64

Conditions: Ta = 25°C

1. Regulation - Line & Load, C.V mode (Readings in [V])

	Vin (AC)					
Io	**85**	**100**	**200**	**265**	**Line Regulation**	
0%	649.8777	649.8796	649.8809	649.8819	4.2	0.001
25%	649.8866	649.8876	649.8877	649.8886	2.0	0.000
50%	649.8880	649.8886	649.8886	649.8886	0.6	0.000
75%	649.8894	649.8894	649.8895	649.8901	0.7	0.000
100%	649.8901	649.8905	649.8909	649.8904	0.8	0.000
Load Regulation	12.4	10.9	10.0	8.5	**ΔV(mV)**	**(%)**
	0.002	0.002	0.002	0.001	**(%)**	

2. Temperature drift, C.V mode

Conditions: Vin:100Vac
Iout:100%

Ta	**0°C**	**25°C**	**50°C**	**Temp. Coefficient (0°C~50°C)**	
Vout	650.079	649.917	649.792	287 mV	9 ppm/°C

2.1 Steady state data

(1) Regulation - Line & Load, Temperature drift

Z160-2.6

Conditions: Ta = 25°C

1. Regulation - Line & Load, C.C mode (*) (Readings in [A])

	Vin (AC)					
Vo	**85**	**100**	**200**	**265**	**Line Regulation**	
0%	2.5996	2.5996	2.5996	2.5996	0.0	0.000
25%	2.5993	2.5993	2.5993	2.5993	0.0	0.000
50%	2.5993	2.5993	2.5992	2.5992	0.1	0.004
75%	2.5990	2.5990	2.5990	2.5990	0.0	0.000
100%	2.5987	2.5988	2.5987	2.5987	0.1	0.004
Load Regulation	0.9	0.8	0.9	0.9	**ΔI(mA)**	**(%)**
	0.035	0.031	0.035	0.035	**(%)**	

Notes:
(*) Not including load regulation thermal drift effect.

2. Temperature drift, C.C mode

Conditions: Vin:100Vac
Iout:100%

Ta	**0°C**	**25°C**	**50°C**	**Temp. Coefficient (0°C~50°C)**	
Iout	2.6030	2.6015	2.6012	1.8 mA	14 ppm/°C

2.1 Steady state data

(1) Regulation - Line & Load, Temperature drift

Z650-0.64

Conditions: Ta = 25°C

1. Regulation - Line & Load, C.C mode (*) (Readings in [A])

	Vin (AC)					
Vo	**85**	**100**	**200**	**265**	**Line Regulation**	
0%	0.6399	0.6399	0.6399	0.6399	0.0	0.000
25%	0.6400	0.6400	0.6400	0.6400	0.0	0.000
50%	0.6400	0.6400	0.6400	0.6400	0.0	0.000
75%	0.6400	0.6400	0.6400	0.6400	0.0	0.000
100%	0.6400	0.6400	0.6400	0.6401	0.1	0.016
Load Regulation	0.1	0.1	0.1	0.2	**ΔI(mA)**	**(%)**
	0.016	0.016	0.016	0.031	**(%)**	

Notes:
(*) Not including load regulation thermal drift effect.

2. Temperature drift, C.C mode

Conditions: Vin:100Vac
Iout:100%

Ta	**0°C**	**25°C**	**50°C**	**Temp. Coefficient (0°C~50°C)**	
Iout	0.6399	0.6400	0.6404	0.5 mA	16 ppm/°C

2.1 Steady state data

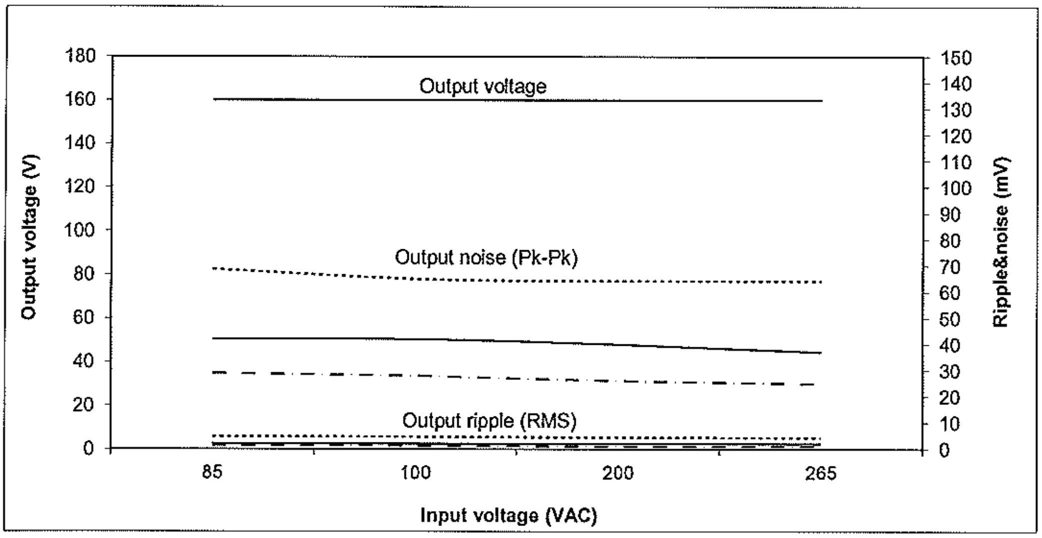
(2) Output voltage and ripple voltage v.s input voltage

C.V mode

Conditions: Iout:100%

Z160-2.6

Ta: 0°C / 25°C / 50°C



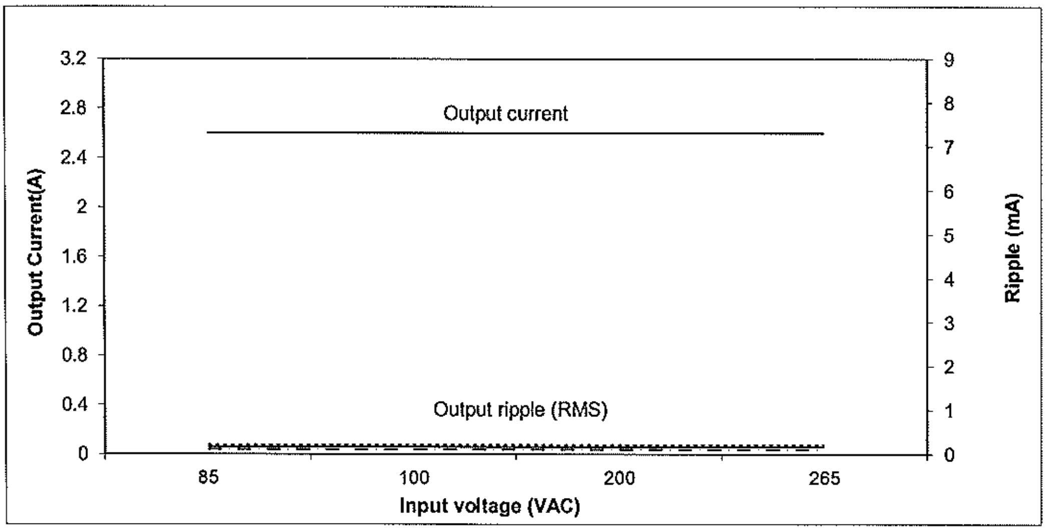
(3) Output current and ripple current v.s input voltage

C.C mode

Conditions: Vout:100%

Z160-2.6

Ta: 0°C / 25°C / 50°C



2.1 Steady state data

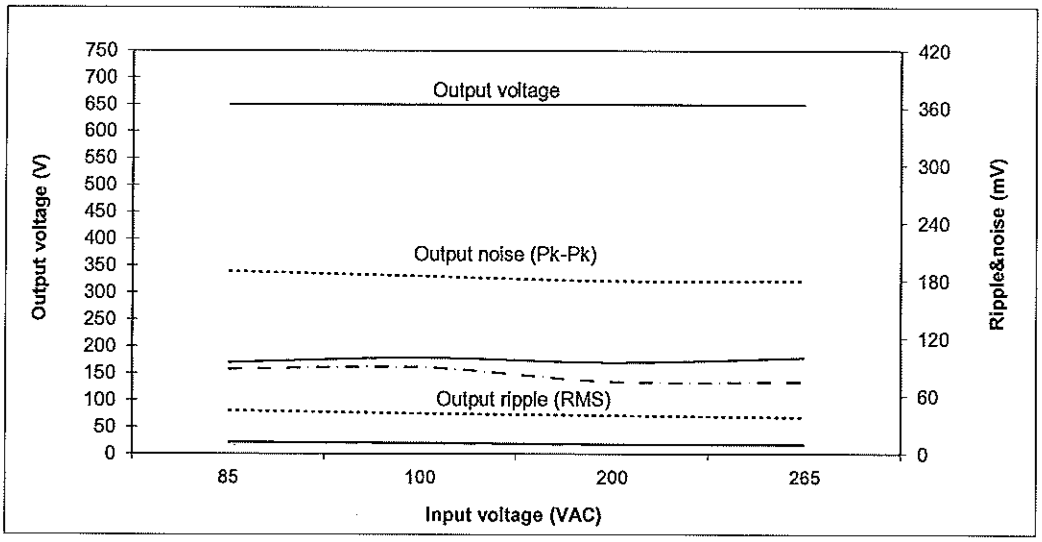
(2) Output voltage and ripple voltage v.s input voltage

C.V mode

Conditions: Iout:100%

Z650-0.64

Ta: 0°C ------------
25°C —·—·—·—·—
50°C ————



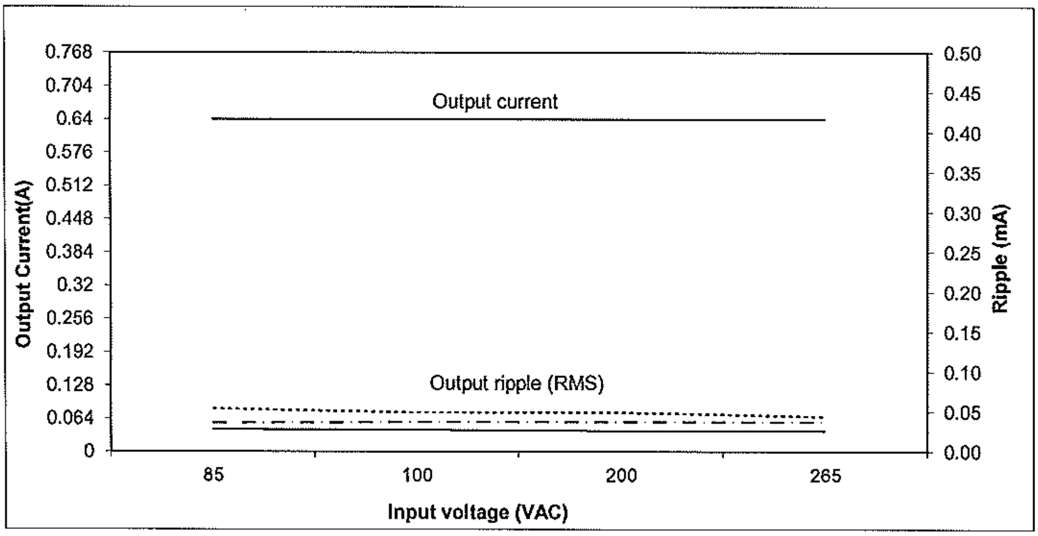
(3) Output current and ripple current v.s input voltage

C.C mode

Conditions: Vout:100%

Z650-0.64

Ta: 0°C ------------
25°C —·—·—·—·—
50°C ————

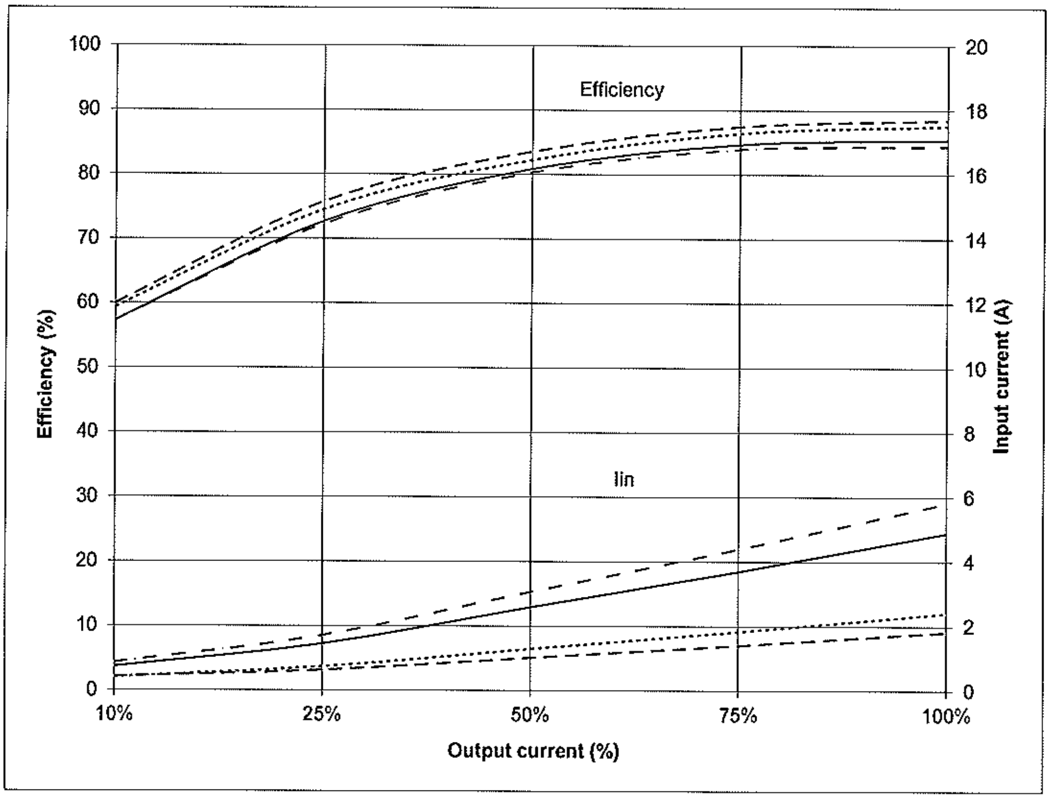


2.1 Steady state data

(4) Efficiency and Input current vs. Output current

Conditions:
Vin: 85 VAC
100VAC
200 VAC
265 VAC
Vout:100%
Ta: 25°C

Z160-2.6

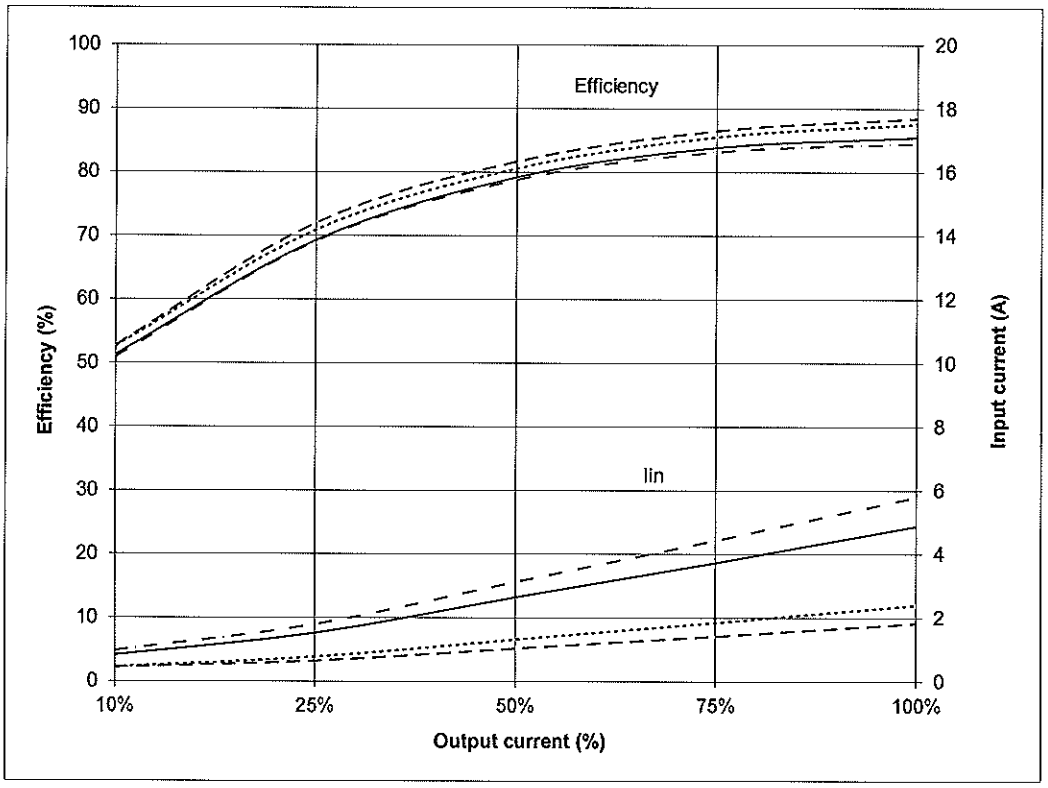


2.1 Steady state data

(4) Efficiency and Input current vs. Output current

Conditions:
Vin: 85 VAC
100VAC
200 VAC
265 VAC
Vout:100%
Ta: 25°C

Z650-0.64

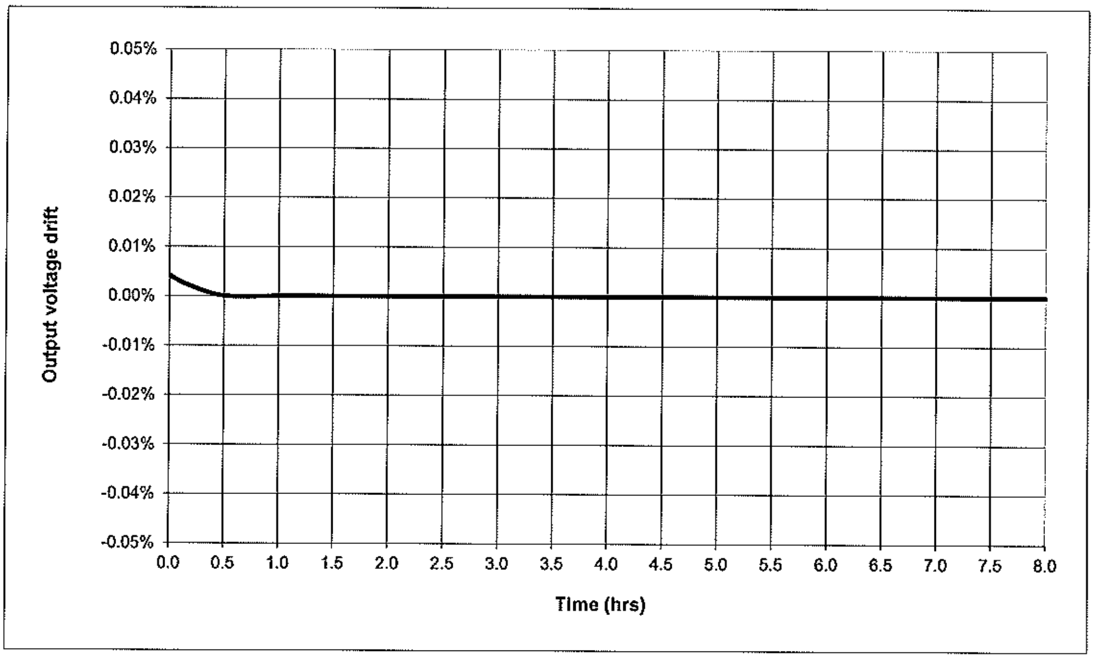


2.2 Warm up drift & stability

Conditions: Vin:100Vac
Vout: 100%
Iout: 100%
Ta = 25°C

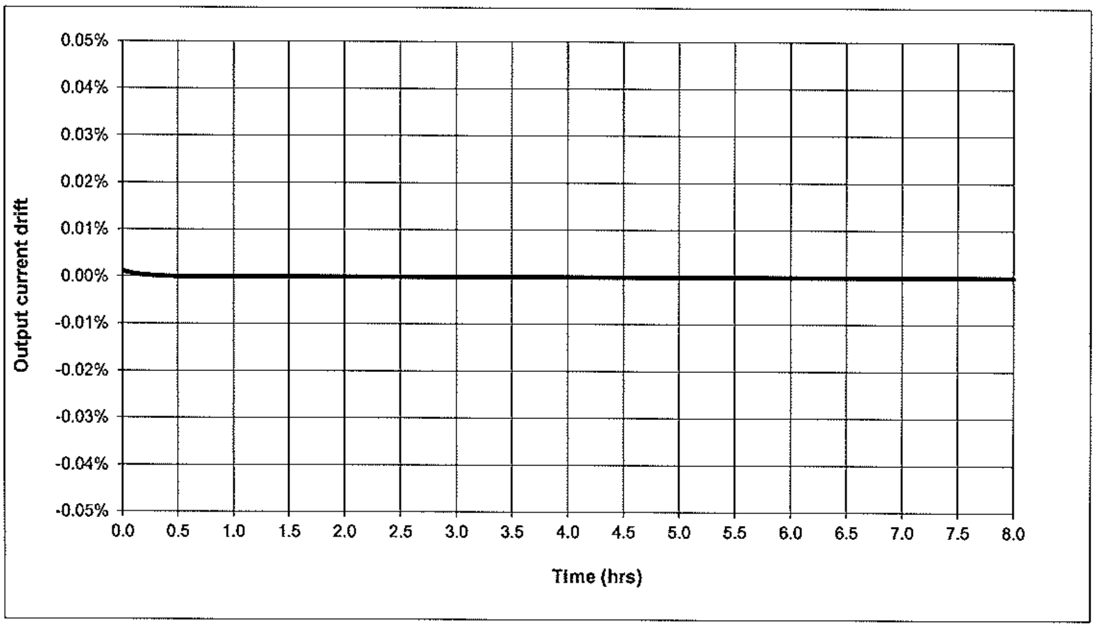
C.V mode

Z160-2.6



C.C mode

Z160-2.6

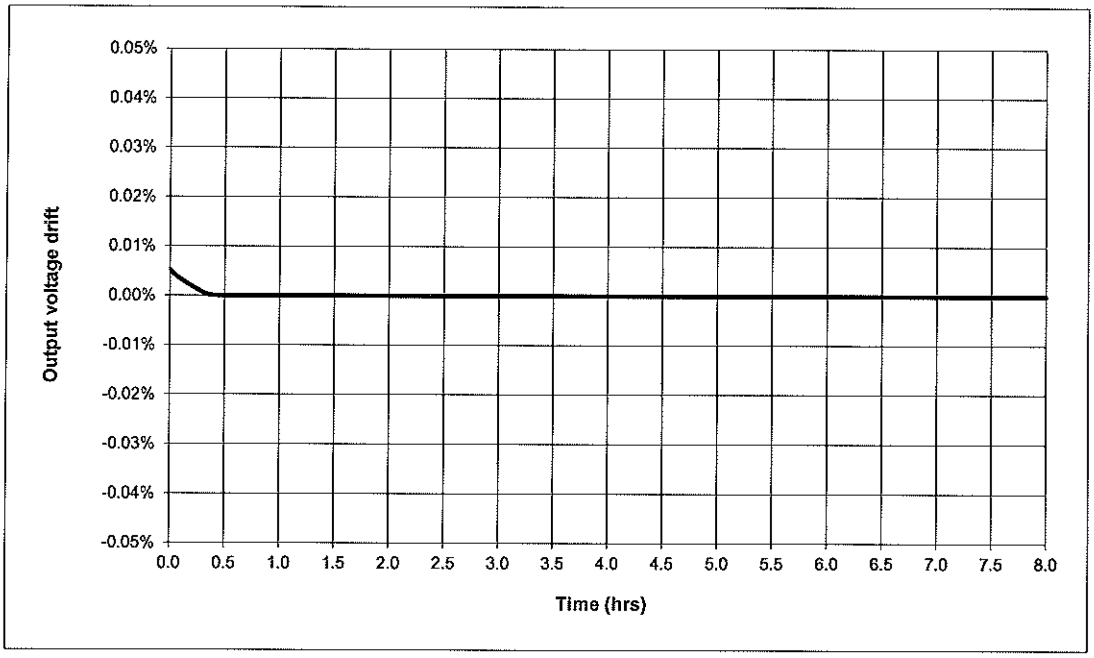


2.2 Warm up drift & stability

Conditions: Vin:100Vac
Vout: 100%
Iout: 100%
Ta = 25°C

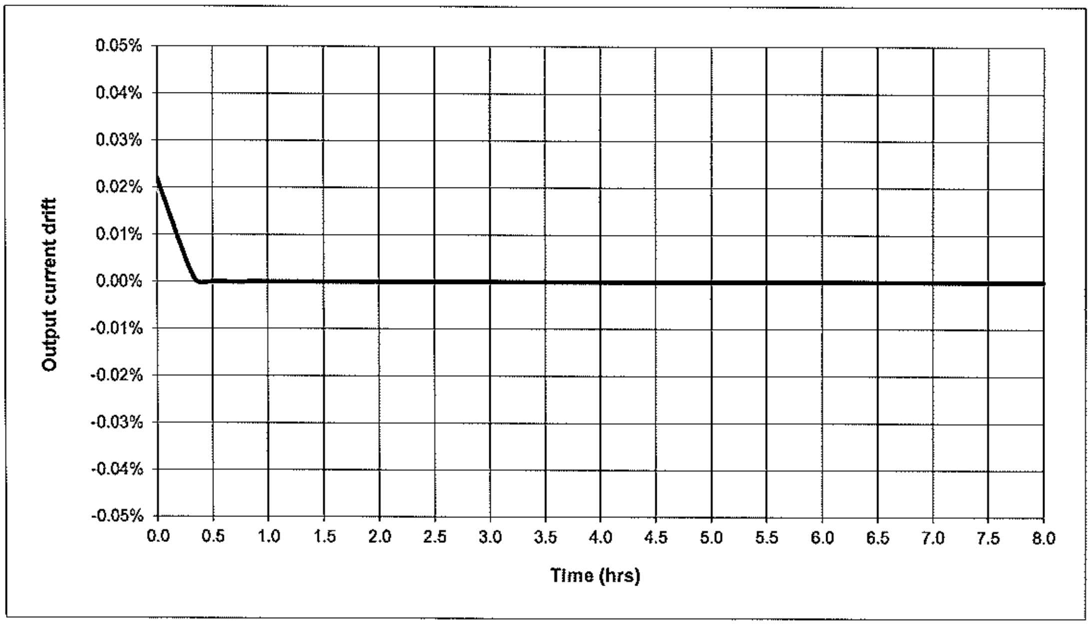
C.V mode

Z650-0.64



C.C mode

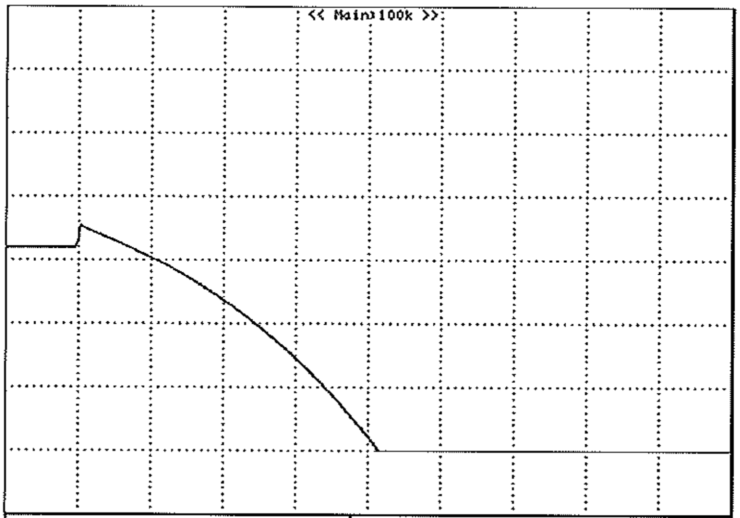
Z650-0.64



2.3 Over voltage protection (OVP) characteristics

Conditions: Vin:100Vac
Iout: 0%
Ta = 25°C

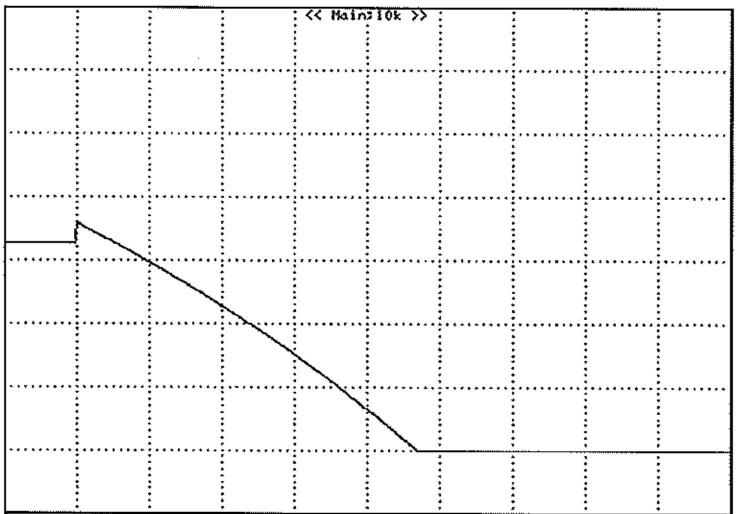
Z160-2.6



$50^{V}/_{DIV}$	$500^{ms}/_{DIV}$

OVP setting: 176V

Z650-0.64



$200^{V}/_{DIV}$	$500^{ms}/_{DIV}$

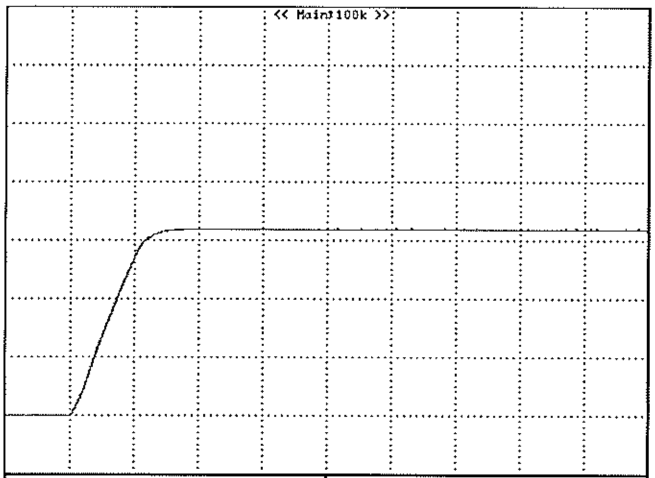
OVP setting: 717V

2.4 ON/OFF Output rise characteristics

Conditions: Vin:100Vac
Vout: 100%
Iout: 0%
Iset=105%
Ta = 25°C

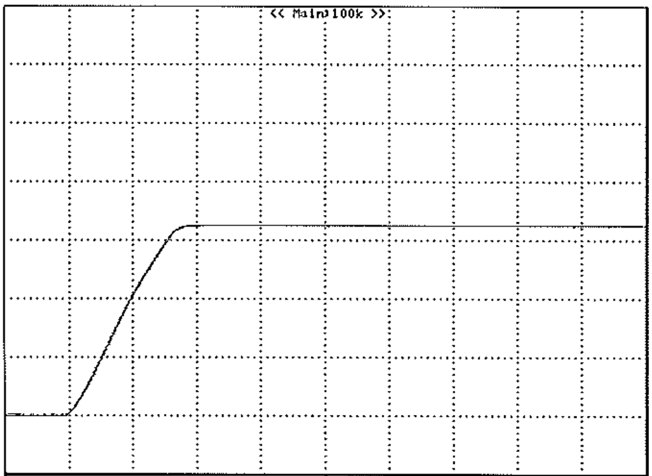
C.V mode

Z160-2.6



50 V/DIV	20 ms/DIV

Z650-0.64



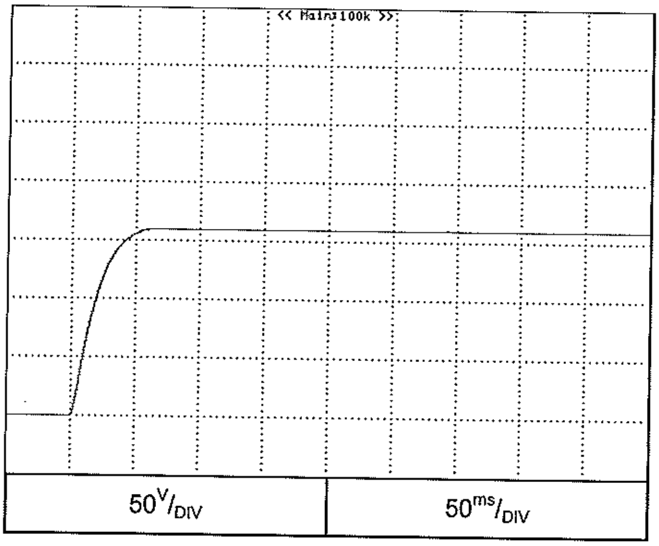
200 V/DIV	20 ms/DIV

2.4 ON/OFF Output rise characteristics

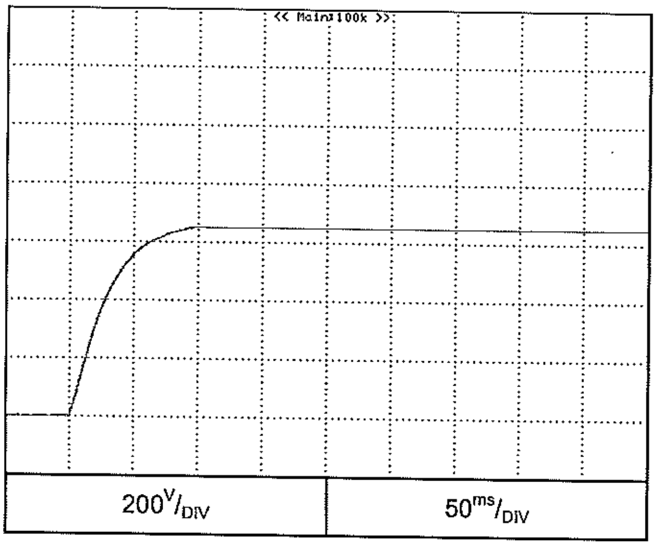
Conditions: Vin:100Vac
Vout: 100%
Iout: 100%
Iset=105%
Load: CR
Ta = 25°C

C.V mode

Z160-2.6



Z650-0.64

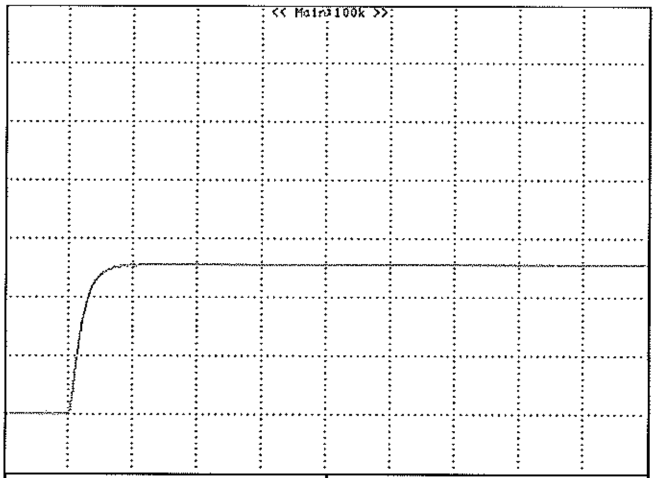


2.4 ON/OFF Output rise characteristics

Conditions: Vin:100Vac
Vout: 100%
Iout: 100%
Vset=105%
Load: CR
Ta = 25°C

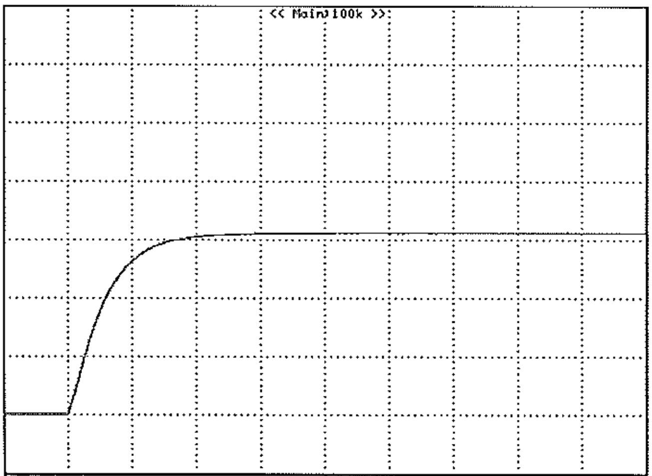
C.C mode

Z160-2.6



$1^{A}/_{DIV}$	$100^{ms}/_{DIV}$

Z650-0.64



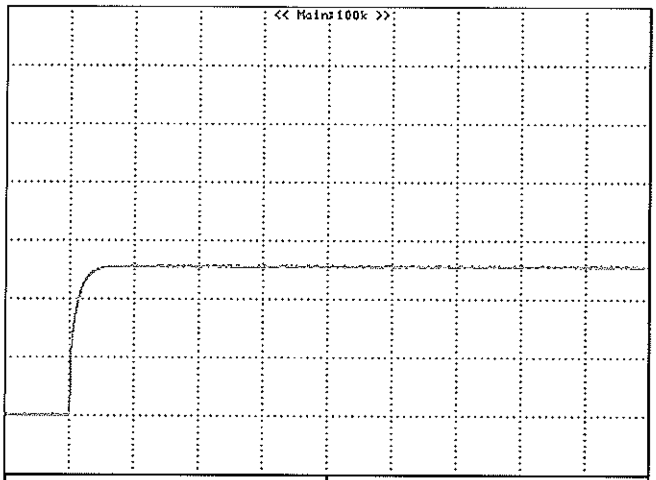
$0.2^{A}/_{DIV}$	$50^{ms}/_{DIV}$

2.4 ON/OFF Output rise characteristics

Conditions: Vin:100Vac
Iout: 100%
Vset=105%
shorted output
Ta = 25°C

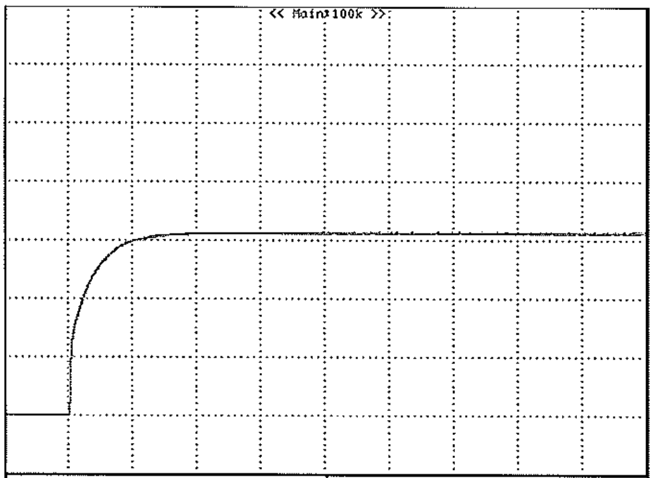
C.C mode

Z160-2.6



$1^{A}/_{DIV}$	$50^{ms}/_{DIV}$

Z650-0.64



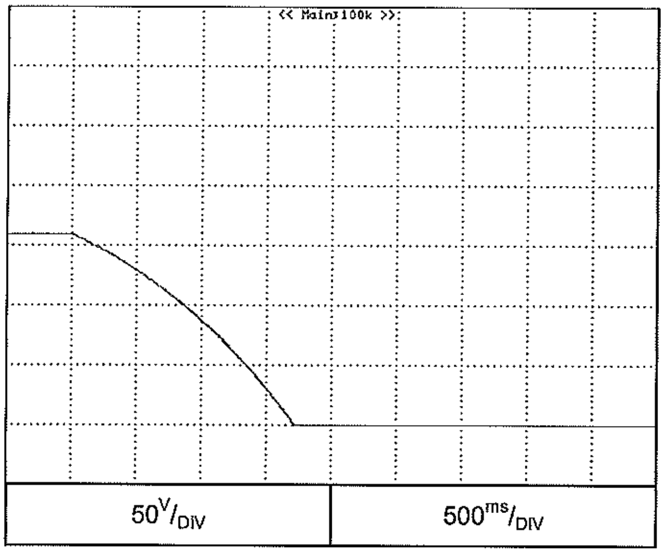
$0.2^{A}/_{DIV}$	$20^{ms}/_{DIV}$

2.5 ON/OFF Output fall characteristics

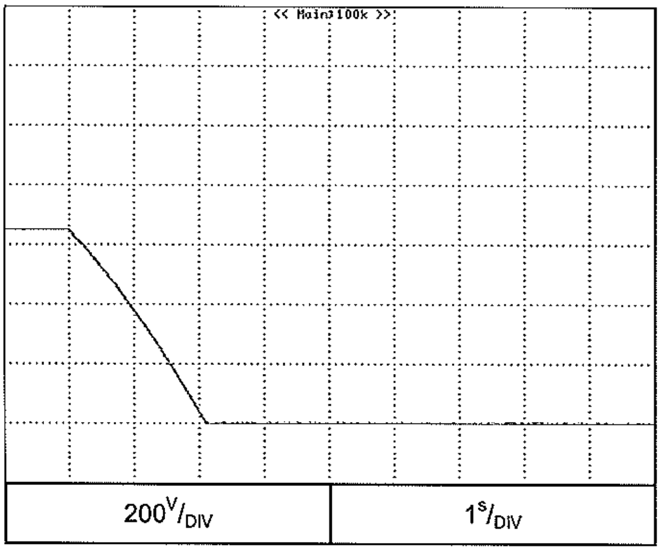
Conditions: Vin:100Vac
Vout: 100%
Iout: 0%
Iset=105%
Ta = 25°C

C.V mode

Z160-2.6



Z650-0.64

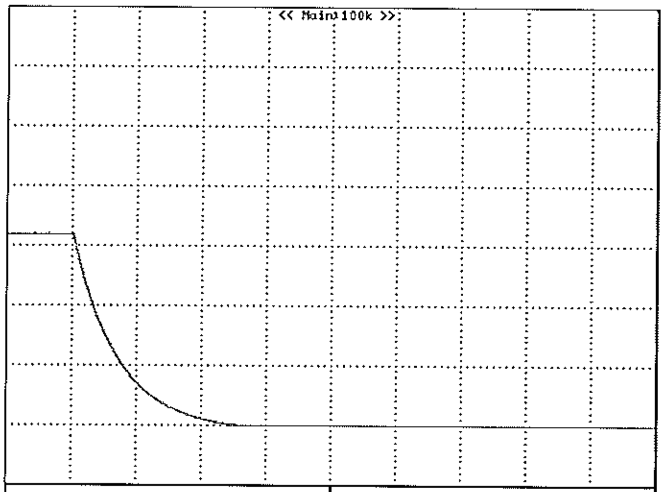


2.5 ON/OFF Output fall characteristics

Conditions: Vin:100Vac
Vout: 100%
Iout: 100%
Iset=105%
Load: CR
Ta = 25°C

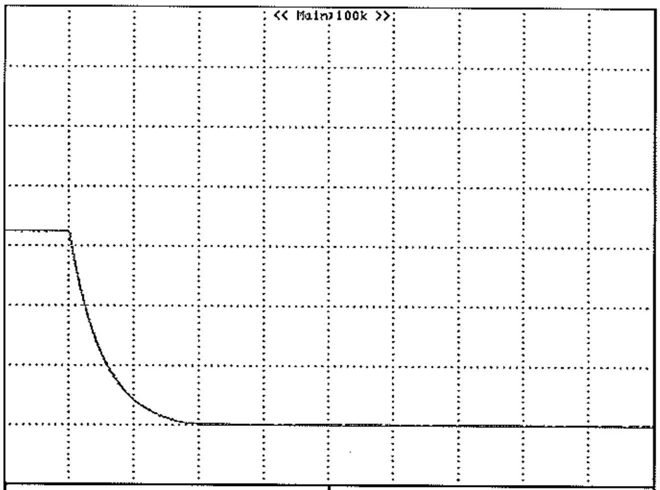
C.V mode

Z160-2.6



$50^{V}/_{DIV}$	$50^{ms}/_{DIV}$

Z650-0.64



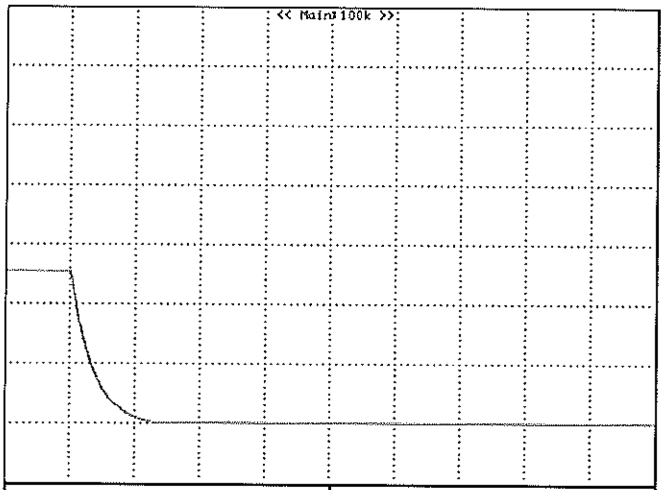
$200^{V}/_{DIV}$	$100^{ms}/_{DIV}$

2.5 ON/OFF Output fall characteristics

Conditions: Vin:100Vac
Vout: 100%
Iout: 100%
Vset=105%
Load: CR
Ta = 25°C

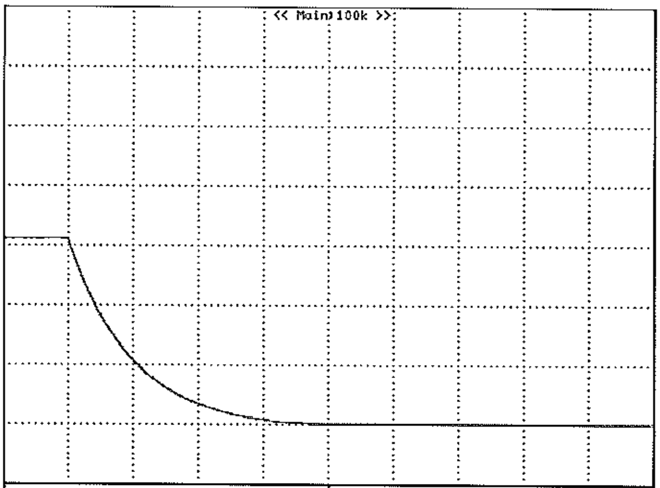
C.C mode

Z160-2.6



$1^{A}/_{DIV}$	$100^{ms}/_{DIV}$

Z650-0.64



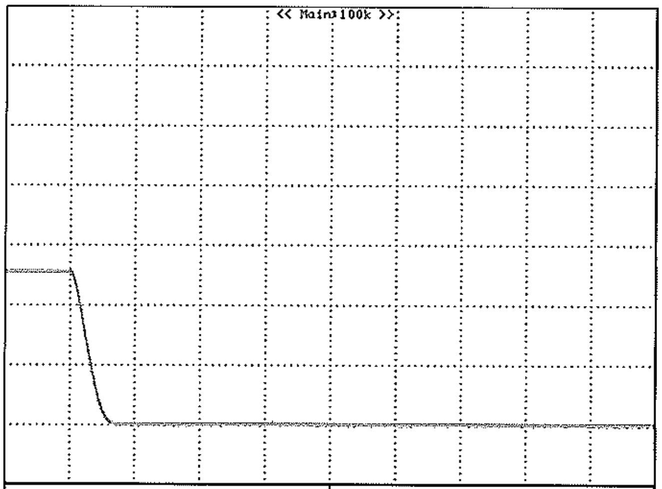
$0.2^{A}/_{DIV}$	$50^{ms}/_{DIV}$

2.5 ON/OFF Output fall characteristics

Conditions: Vin:100Vac
Iout: 100%
Vset=105%
shorted output
Ta = 25°C

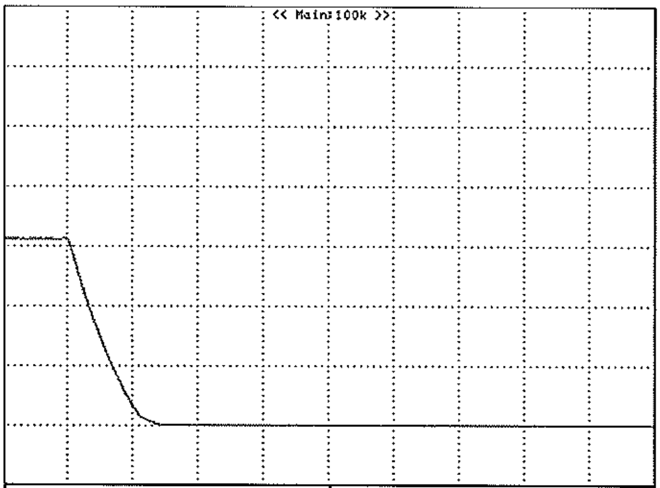
C.C mode

Z160-2.6



$1^{A}/_{DIV}$	$1^{ms}/_{DIV}$

Z650-0.64

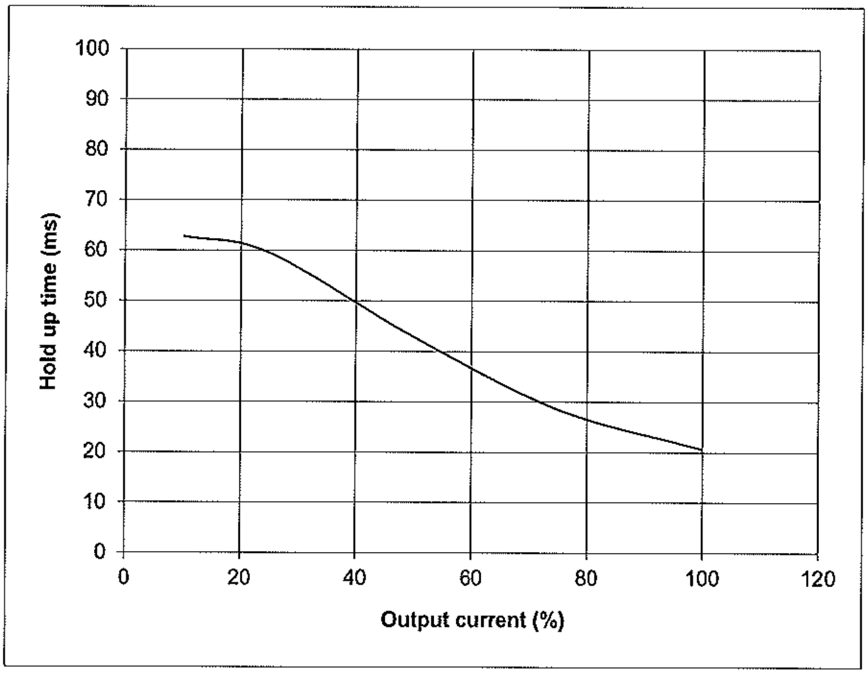


$0.2^{A}/_{DIV}$	$2^{ms}/_{DIV}$

2.6 Hold up time characteristics

Conditions: Vin:100Vac
Vout: 100%
Ta = 25°C

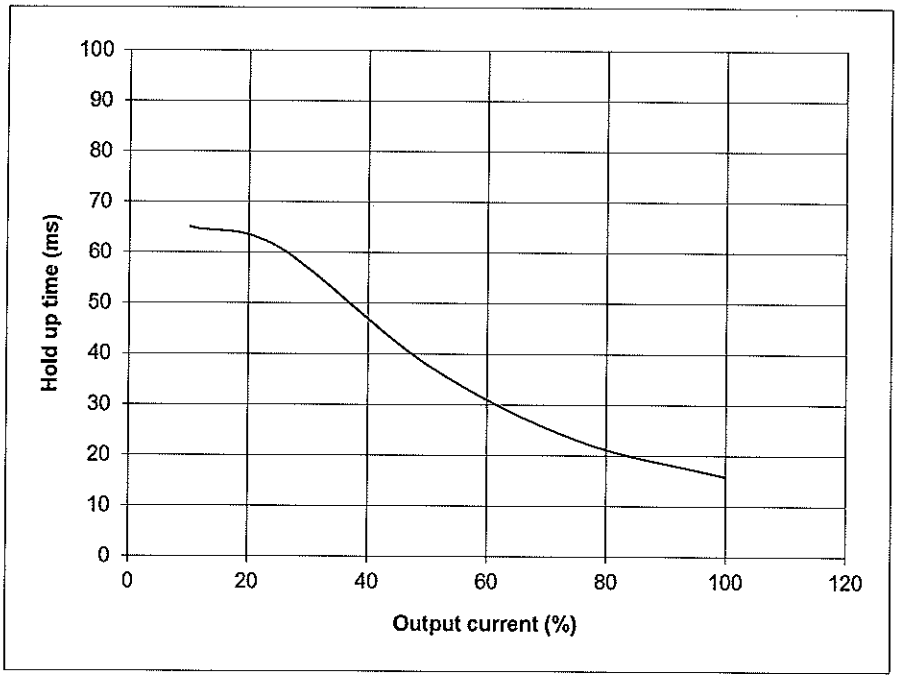
Z160-2.6



2.6 Hold up time characteristics

Conditions: Vin:100Vac
Vout: 100%
Ta = 25°C

Z650-0.64

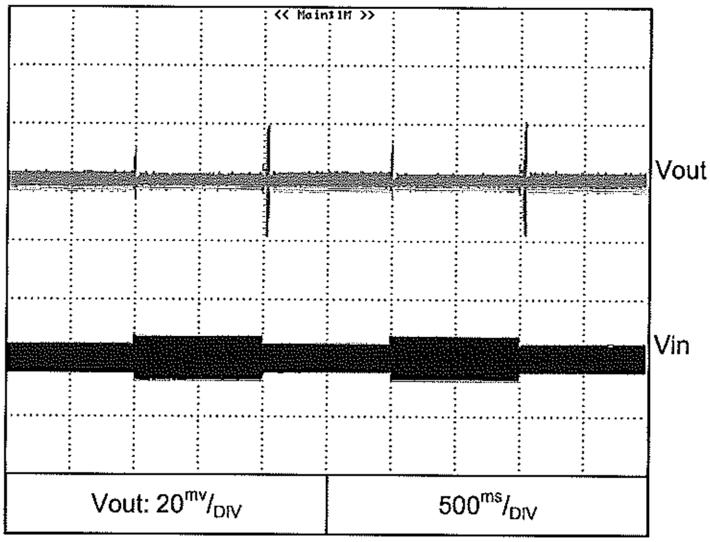


2.7 Dynamic line response characteristics

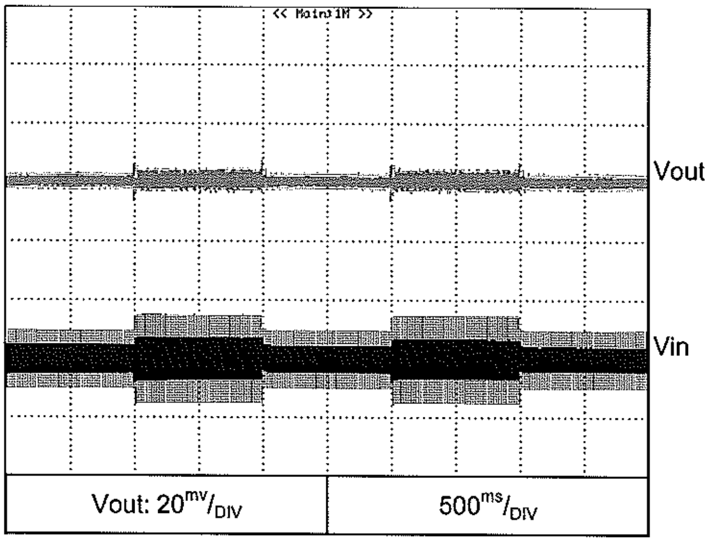
Conditions: Vin:85↔132V
Vout: 100%
Iout: 100%
Ta = 25°C

C.V mode

Z160-2.6



Conditions: Vin:170↔265V
Vout: 100%
Iout: 100%
Ta = 25°C

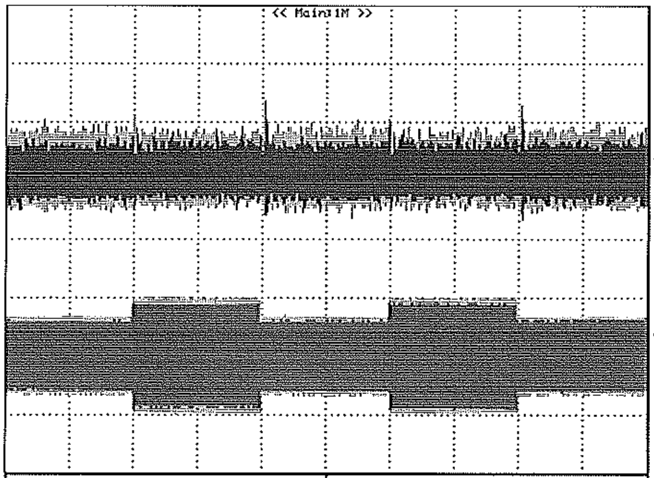


2.7 Dynamic line response characteristics

C.V mode

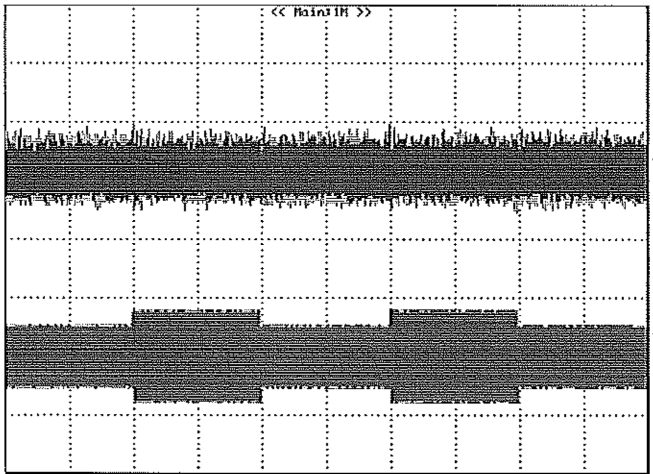
Z650-0.64

Conditions: Vin:85↔132V
Vout: 100%
Iout: 100%
Ta = 25°C



Vout: 50mV/DIV	500ms/DIV

Conditions: Vin:170↔265V
Vout: 100%
Iout: 100%
Ta = 25°C



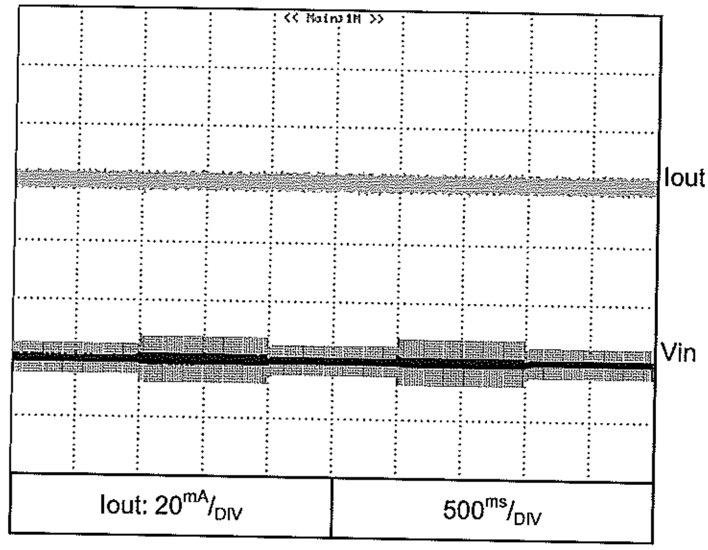
Vout: 50mV/DIV	500ms/DIV

2.7 Dynamic line response characteristics

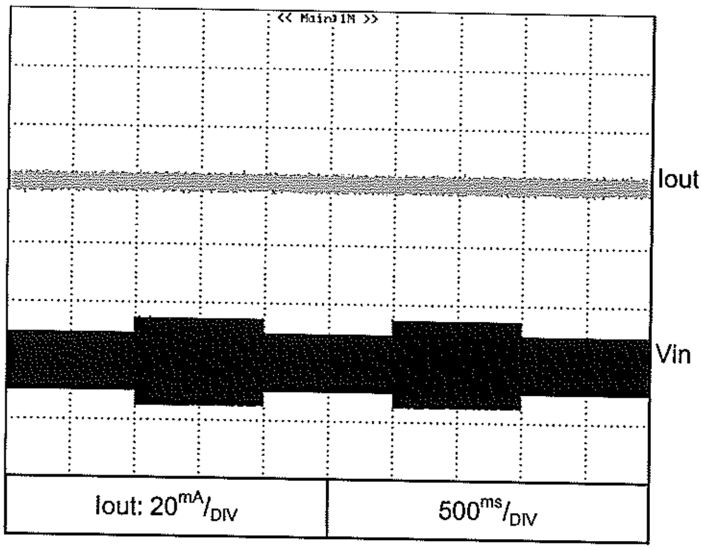
C.C mode

Z160-2.6

Conditions: Vin:85↔132V
Vout: 100%
Iout: 100%
Ta = 25°C



Conditions: Vin:170↔265V
Vout: 100%
Iout: 100%
Ta = 25°C

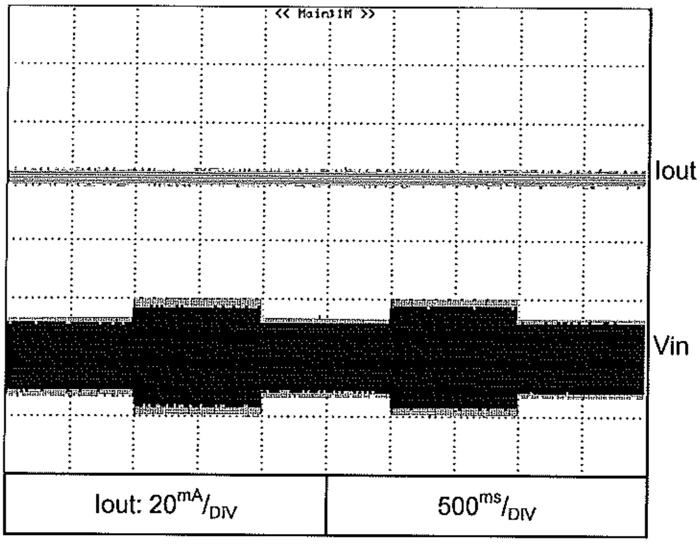


2.7 Dynamic line response characteristics

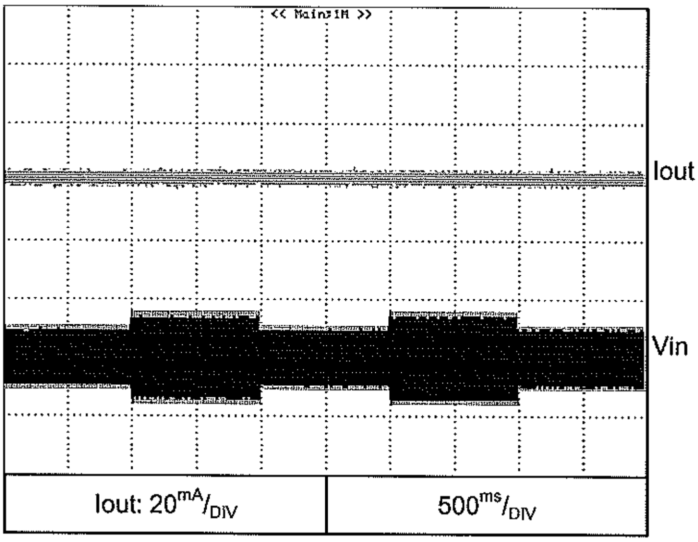
Conditions: Vin:85↔132V
Vout: 100%
Iout: 100%
Ta = 25°C

C.C mode

Z650-0.64



Conditions: Vin:170↔265V
Vout: 100%
Iout: 100%
Ta = 25°C



2.8 Dynamic load response characteristics

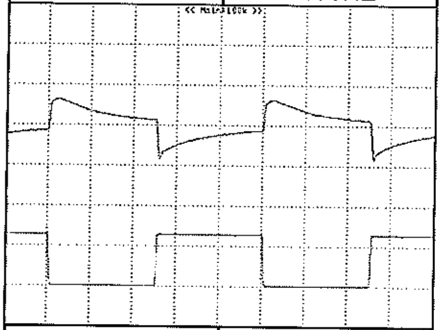
C.V mode

Conditions: Vin:100Vac
Vout: 100%
Ta = 25°C

Load current: tr=tf=100us

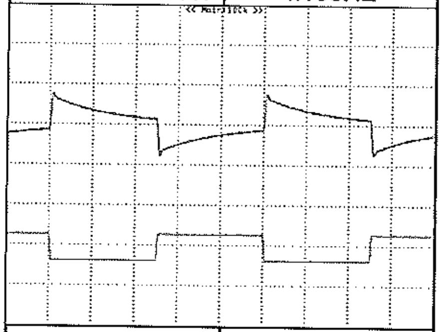
Z160-2.6

Iout:0%↔100%	f:100HZ



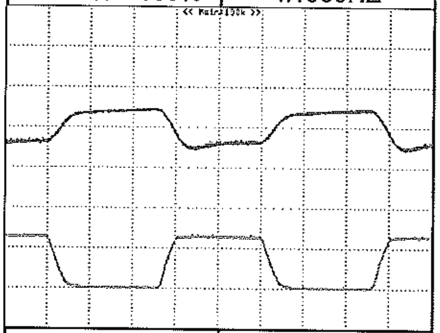
$0.5^{V}/_{DIV}$	$2^{ms}/_{DIV}$
0.20%	-0.26%

Iout:50%↔100%	f:100HZ



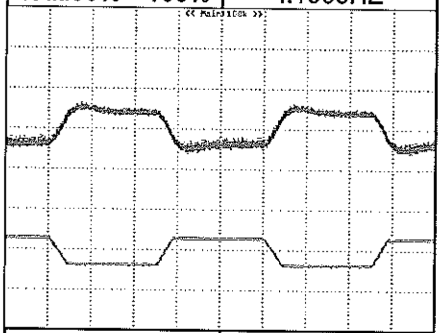
$0.2^{V}/_{DIV}$	$2^{ms}/_{DIV}$
0.10%	-0.10%

Iout:0%↔100%	f:1000HZ



$0.5^{V}/_{DIV}$	$200^{us}/_{DIV}$
0.15%	-0.18%

Iout:50%↔100%	f:1000HZ



$0.2^{V}/_{DIV}$	$200^{us}/_{DIV}$
0.08%	-0.08%

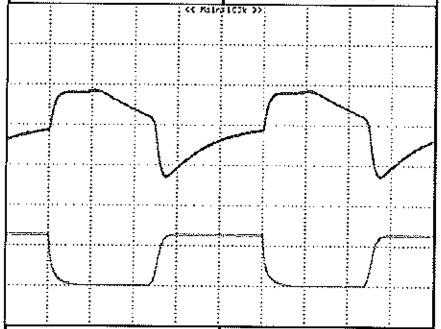
2.8 Dynamic load response characteristics

C.V mode

Conditions: Vin:100Vac
Vout: 100%
Ta = 25°C

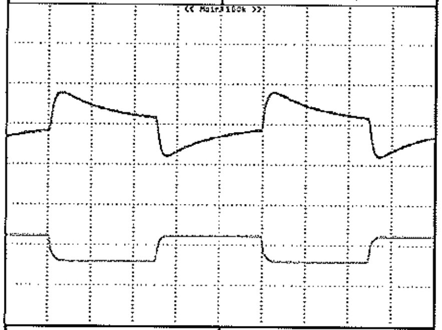
Z650-0.64

Iout:0%↔100%	f:100HZ



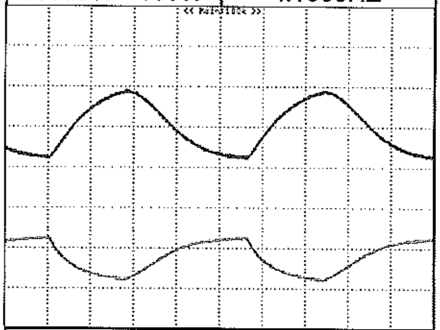
$1^{V}/_{DIV}$	$2^{ms}/_{DIV}$
0.13%	-0.21%

Iout:50%↔100%	f:100HZ



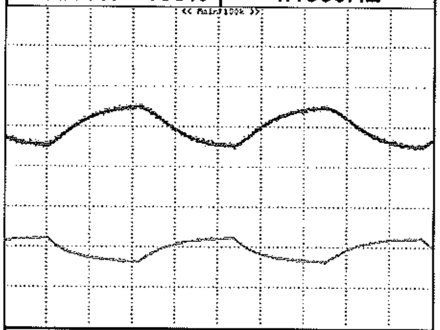
$0.5^{V}/_{DIV}$	$2^{ms}/_{DIV}$
0.06%	-0.06%

Iout:0%↔100%	f:1000HZ



$0.5^{V}/_{DIV}$	$200^{us}/_{DIV}$
0.06%	-0.07%

Iout:50%↔100%	f:1000HZ



$0.5^{V}/_{DIV}$	$200^{us}/_{DIV}$
0.05%	-0.05%

2.8 Dynamic load response characteristics

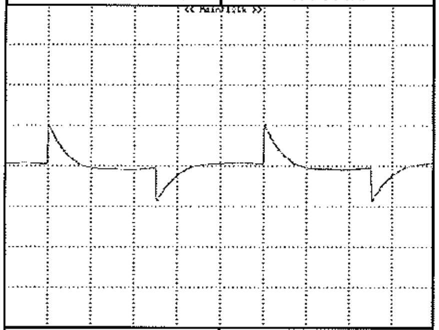
Conditions: Vin:100Vac
Ta = 25°C

C.C mode

Z160-2.6

Io=2.6A

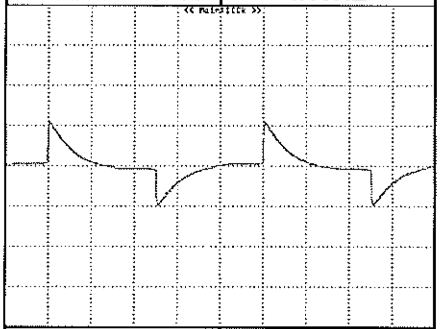
Vout:144↔120V	f:10HZ



0.5A/DIV	20ms/DIV
19.42%	-16.50%

Io=1.3A

Vout:144↔120V	f:10HZ

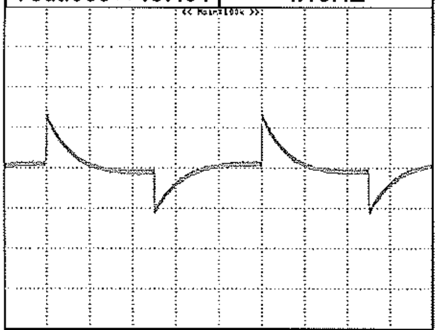


0.2A/DIV	20ms/DIV
8.46%	-7.50%

Z650-0.64

Io=0.64A

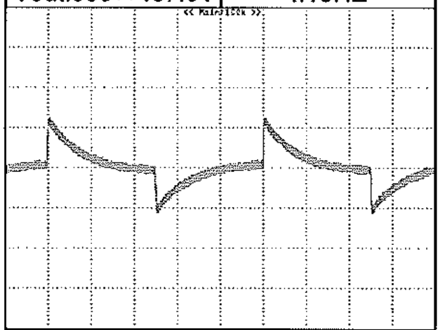
Vout:585↔487.5V	f:10HZ



0.1A/DIV	20ms/DIV
20.49%	-17.68%

Io=0.32A

Vout:585↔487.5V	f:10HZ



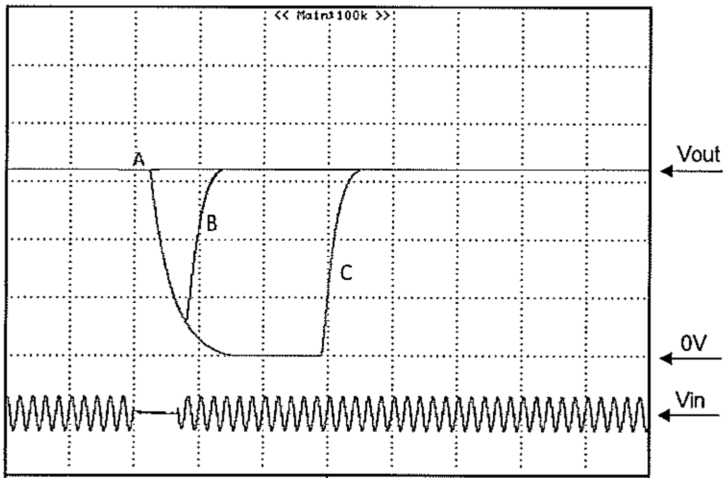
0.05A/DIV	20ms/DIV
9.72%	-8.78%

2.9 Response to brown-out characteristics

Conditions: Vin:100VAC
Vout: 100%
Iout: 100%
Ta = 25°C

C.V mode

Z160-2.6



Vout: 50V/DIV	100ms/DIV

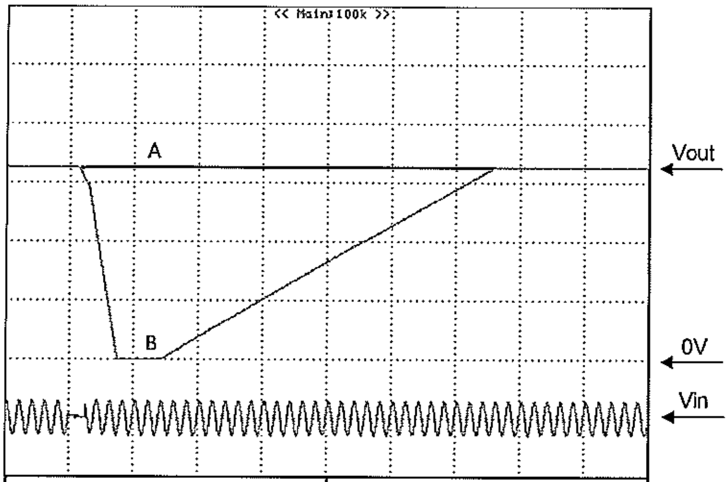
Brown-out time
A - 21mS
B - 26mS
C - 69mS

2.9 Response to brown-out characteristics

C.V mode

Conditions: Vin:100VAC
Vout: 100%
Iout: 100%
Ta = 25°C

Z650-0.64



Vout: 200 V/DIV	100 ms/DIV

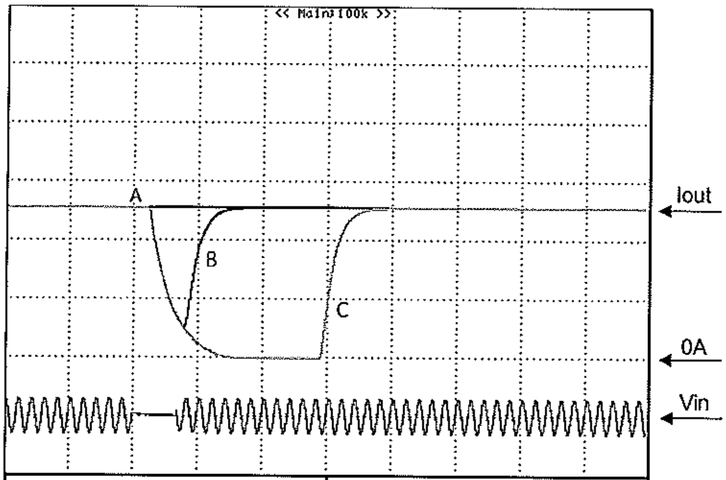
<u>Brown-out time</u>
A - 15ms
B - 27ms

2.9 Response to brown-out characteristics

C.C mode

Conditions: Vin:100VAC
Vout: 100%
Iout: 100%
Ta = 25°C

Z160-2.6



Iout: 1A/DIV	100ms/DIV

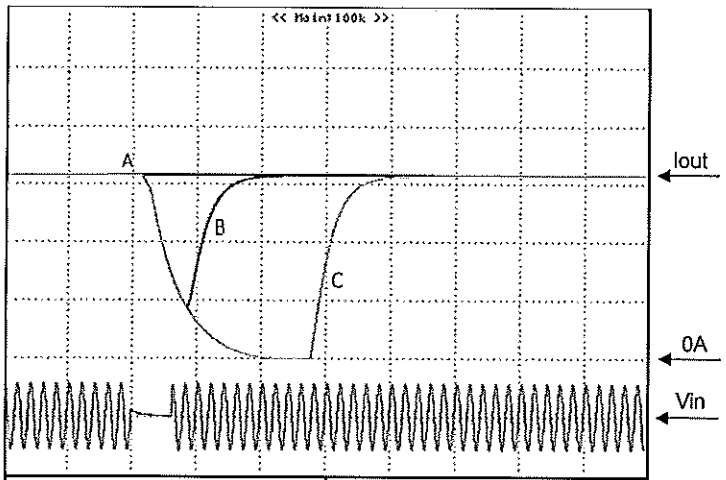
Brown-out time
A - 21mS
B - 26mS
C - 69mS

2.9 Response to brown-out characteristics

C.C mode

Conditions: Vin:100VAC
Vout: 100%
Iout: 100%
Ta = 25°C

Z650-0.64



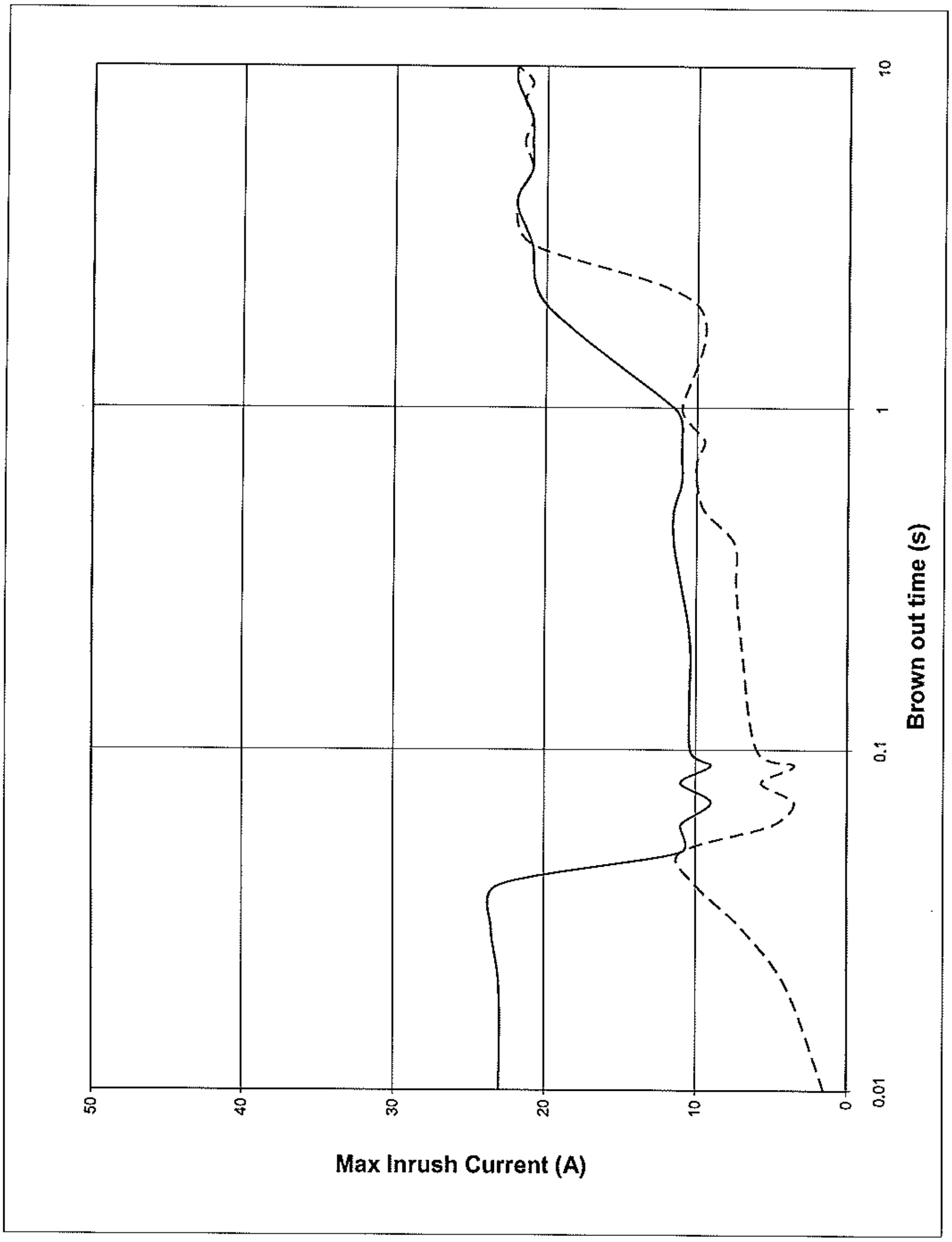
Iout: 0.2 A/DIV	100 ms/DIV

Brown-out time
A - 15mS
B - 28mS
C - 47mS

2.10 Inrush Current Characteristics during line brown outs

Conditions: Vin: 100VAC
Vout: 100%
Iout: 0% ----------
Iout: 100% ——————
Ta = 25°C

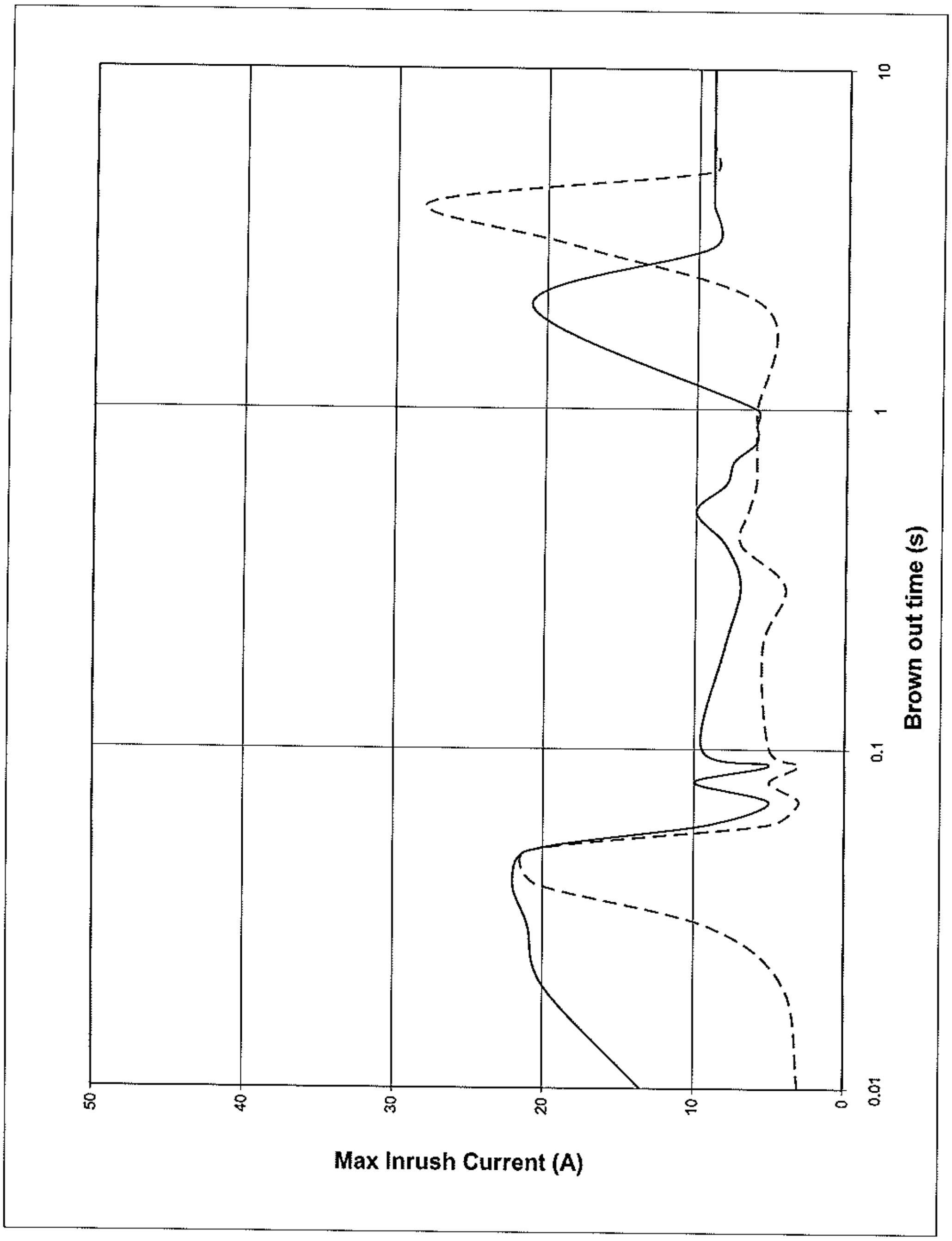
Z160-2.6



2.10 Inrush Current Characteristics during line brown outs

Conditions: Vin: 200VAC
Vout: 100%
Iout: 0% ----------
Iout: 100% ———
Ta = 25°C

Z160-2.6



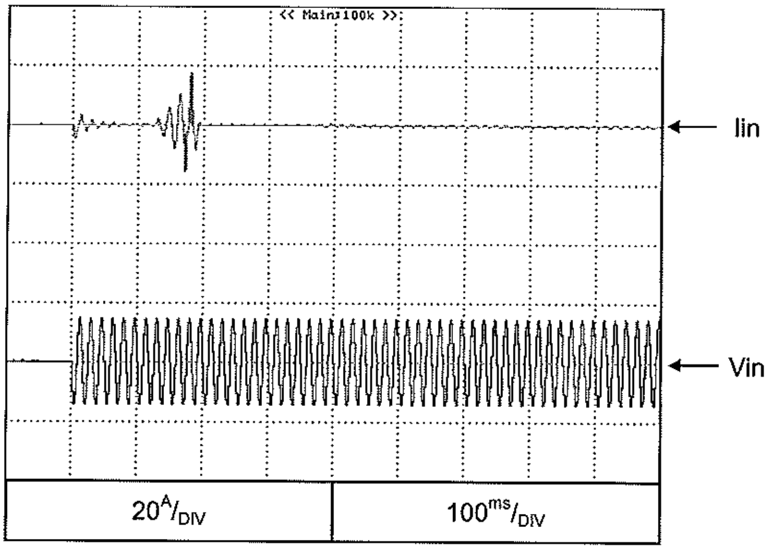
2.11 Inrush current waveform

Conditions: Vin: 100V
Vout: 100%
Iout: 100%
Ta = 25°C

Z160-2.6

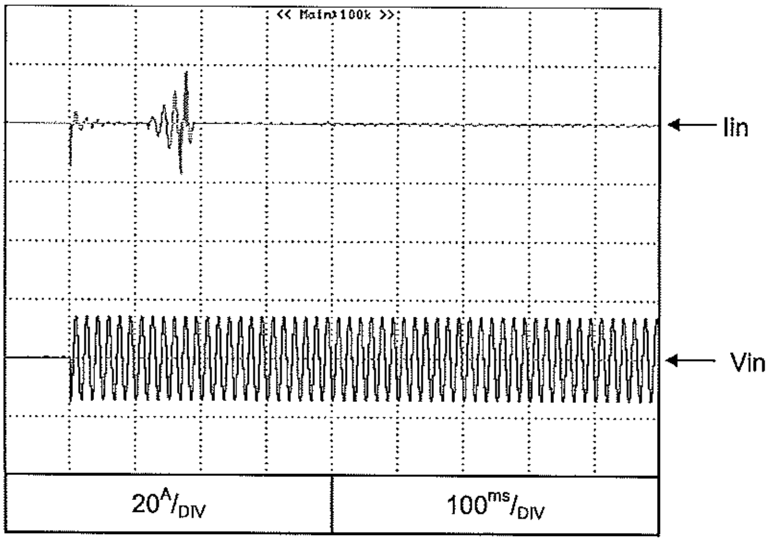
Switch on phase angle of input AC voltage

Φ=0°



Switch on phase angle of input AC voltage

Φ=90°



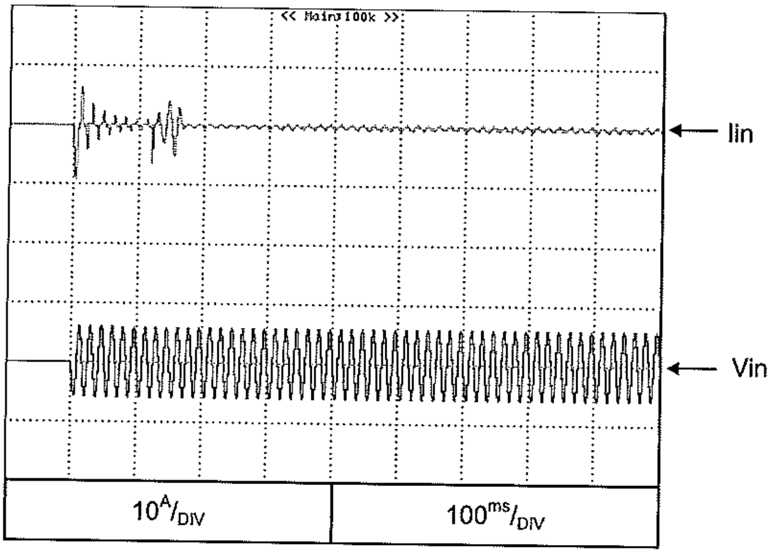
2.11 Inrush current waveform

Conditions: Vin: 200V
Vout: 100%
Iout: 100%
Ta = 25°C

Z160-2.6

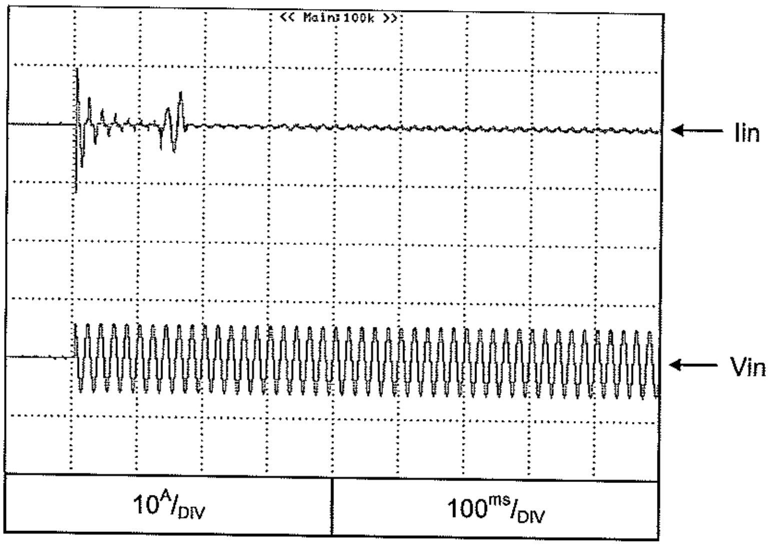
Switch on phase angle of input AC voltage

Φ=0°



Switch on phase angle of input AC voltage

Φ=90°



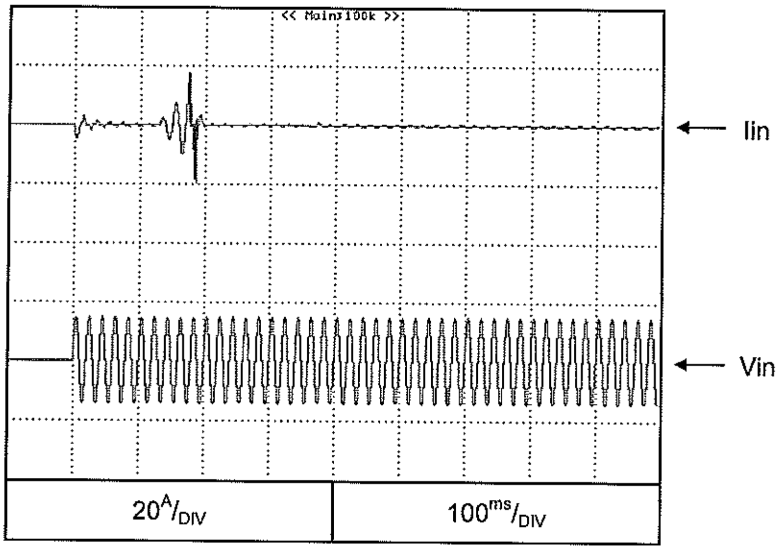
2.11 Inrush current waveform

Conditions: Vin: 100V
Vout: 100%
Iout: 100%
Ta = 25°C

Z650-0.64

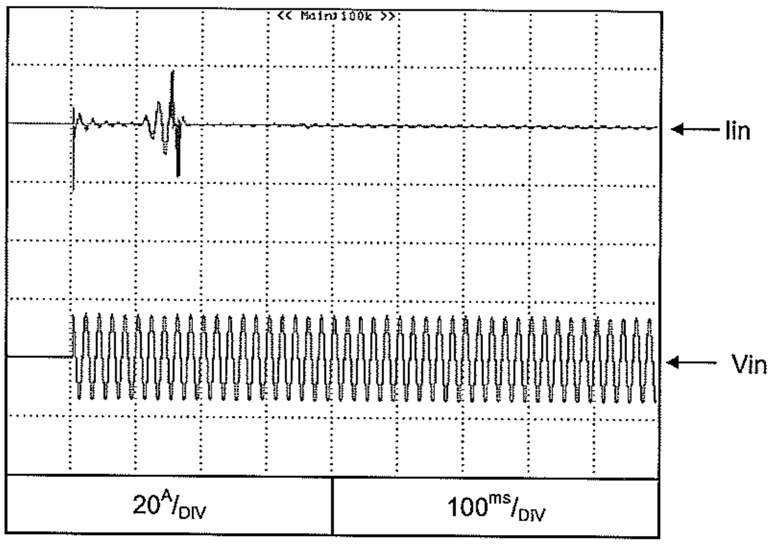
Switch on phase angle of input AC voltage

Φ=0°



Switch on phase angle of input AC voltage

Φ=90°



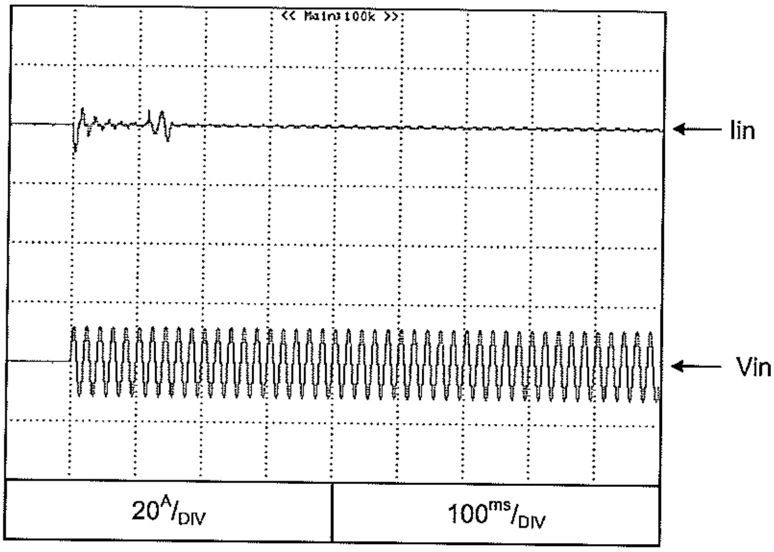
2.11 Inrush current waveform

Conditions: Vin: 200V
Vout: 100%
Iout: 100%
Ta = 25°C

Z650-0.64

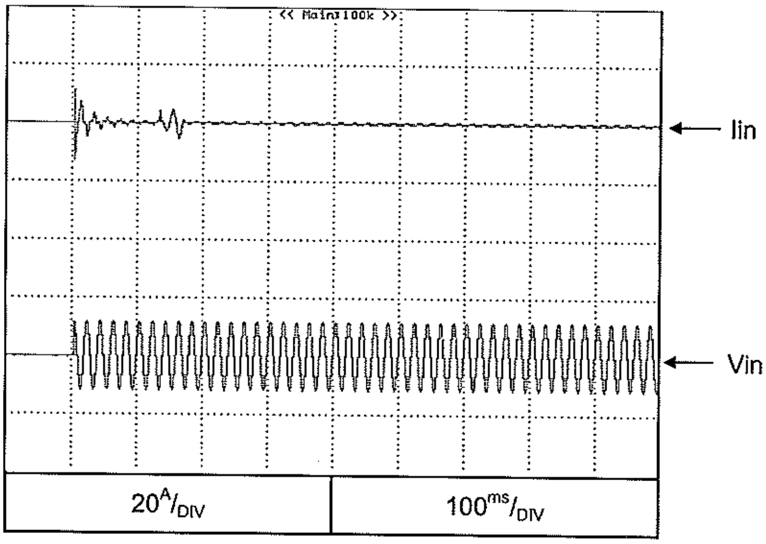
Switch on phase angle of input AC voltage

Φ=0°



Switch on phase angle of input AC voltage

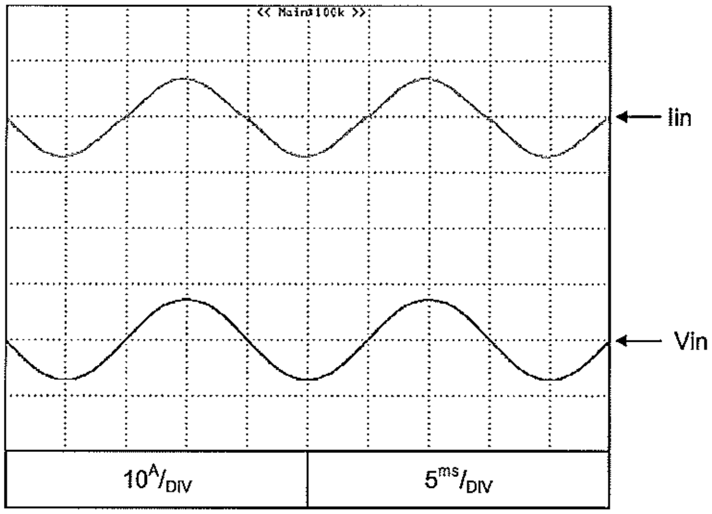
Φ=90°



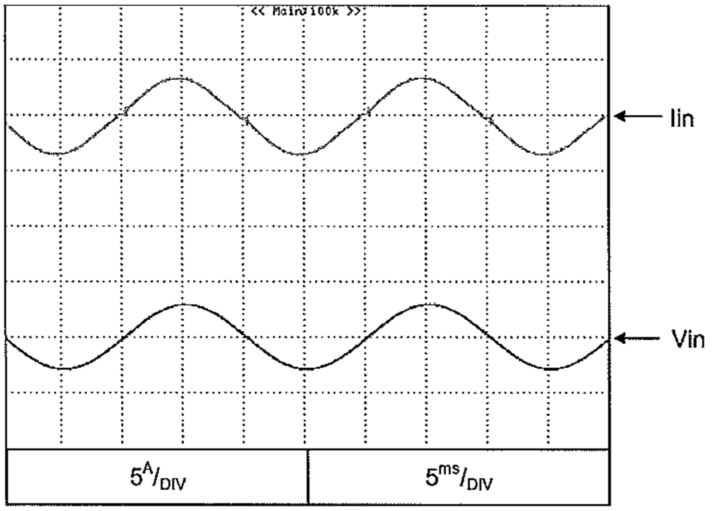
2.12 Input current waveform

Conditions: Vin: 100VAC
Vout: 100%
Iout: 100%
Ta = 25°C

Z160-2.6



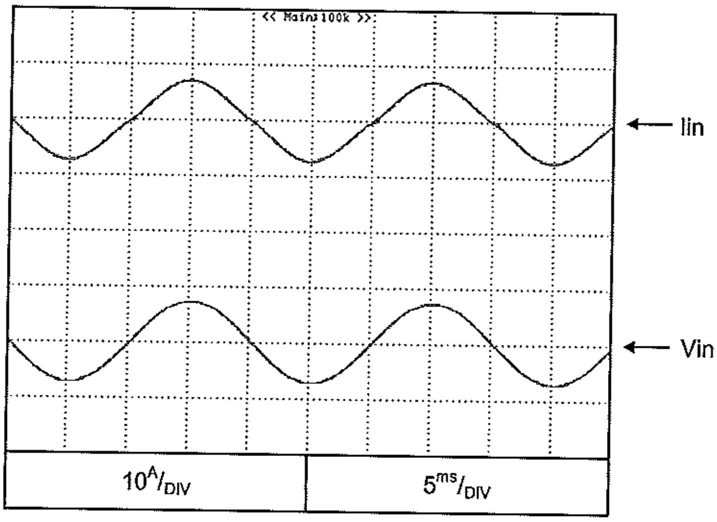
Conditions: Vin: 200VAC
Vout: 100%
Iout: 100%
Ta = 25°C



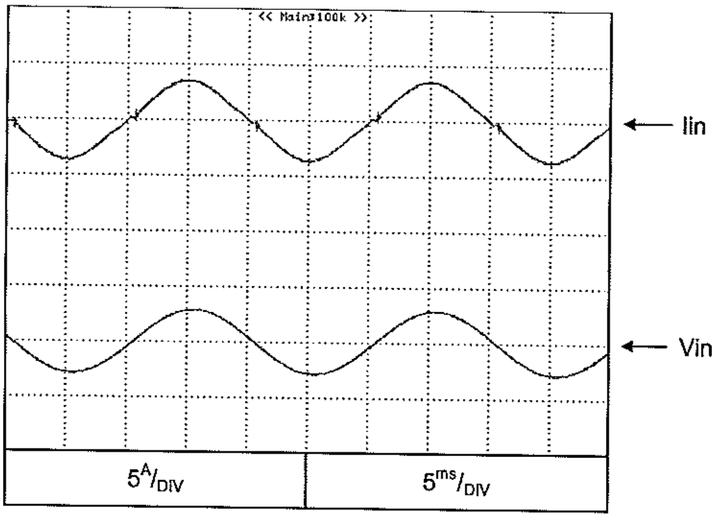
2.12 Input current waveform

Conditions: Vin: 100VAC
Vout: 100%
Iout: 100%
Ta = 25°C

Z650-0.64



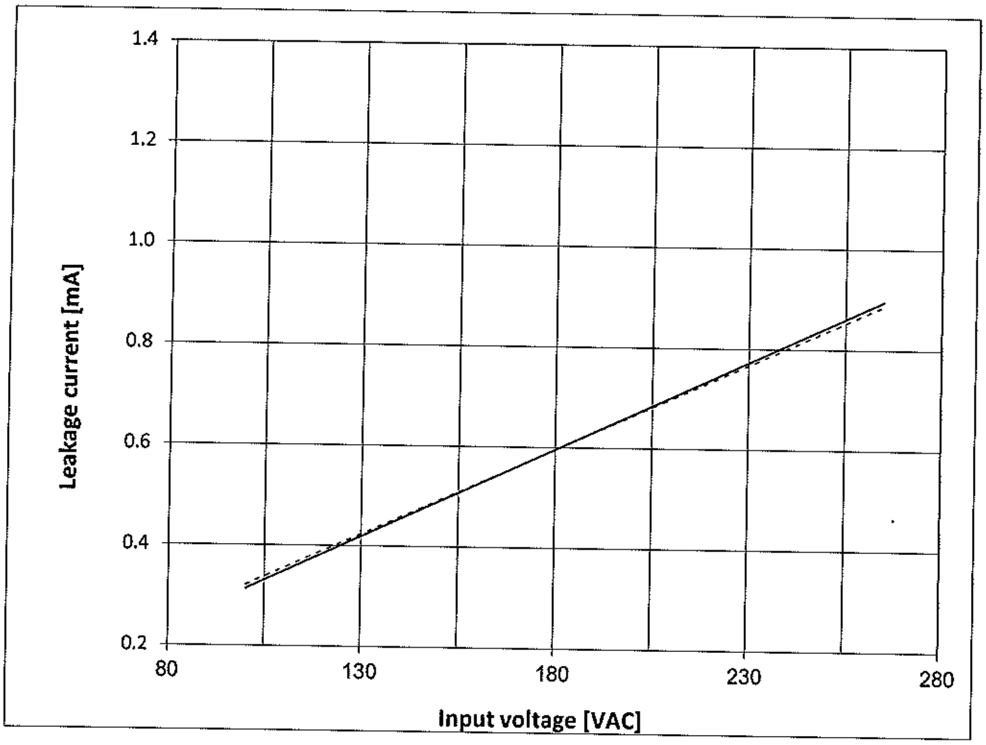
Conditions: Vin: 200VAC
Vout: 100%
Iout: 100%
Ta = 25°C



2.13 Leakage current characteristics

Conditions: Vin: 100~265Vac
Iout: 0% - - - - -
Iout:100% ————
Ta = 25°C
f=50HZ

Z650-0.64



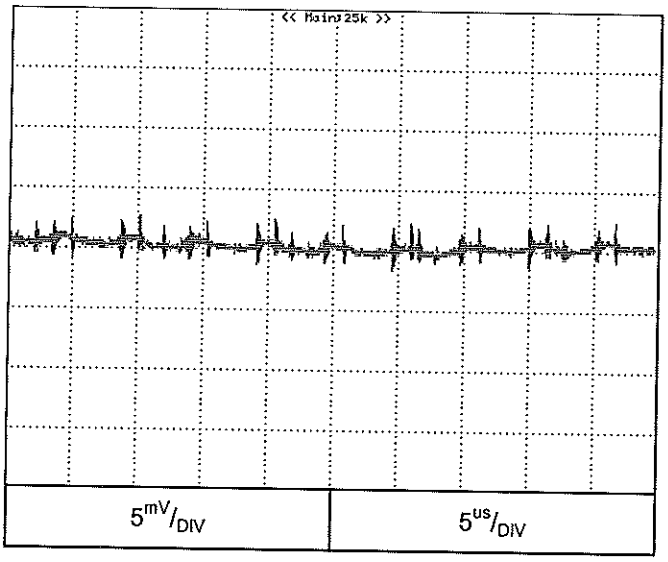
2.14 Output voltage ripple & noise waveform

C.V mode

Conditions: Vin: 100VAC
Vout: 100%
Iout: 100%
Ta = 25°C

Normal Mode

Z160-2.6



Z650-0.64